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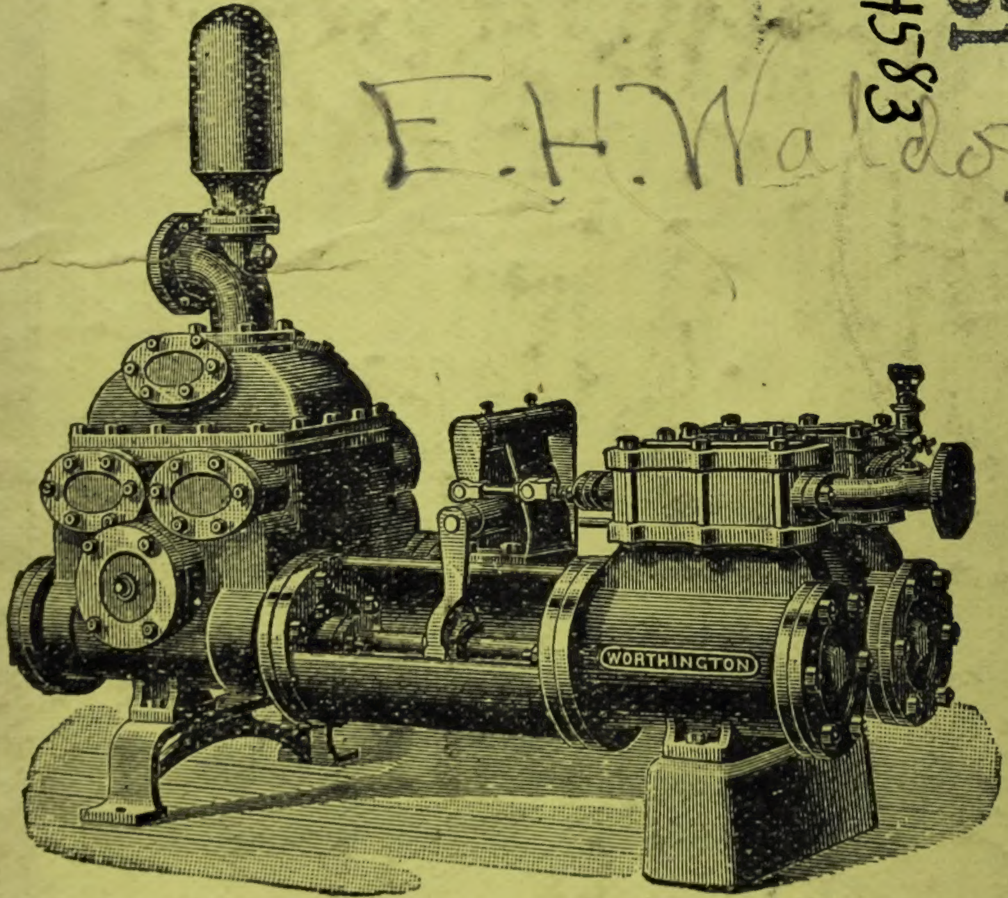

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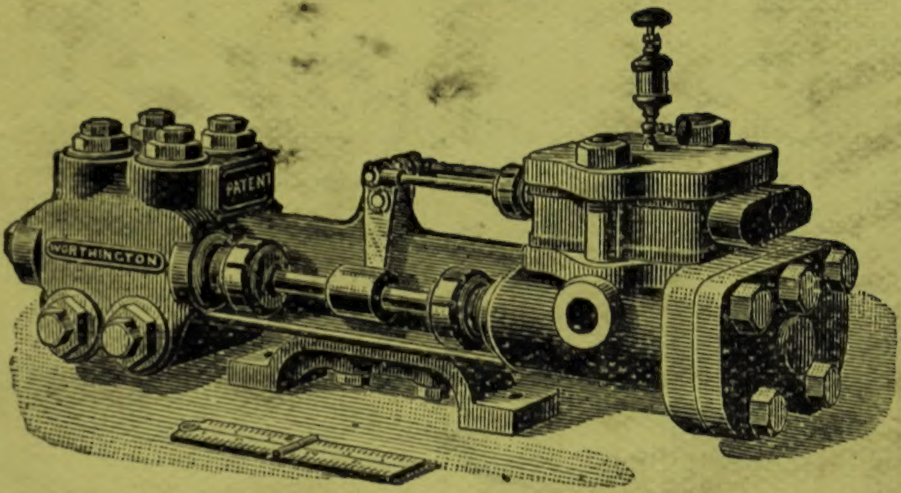

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WALDO —

A
POCKET-BOOK FOR CHEMISTS

CHEMICAL MANUFACTURERS, METALLURGISTS, DYERS, DISTILLERS, BREWERS, SUGAR REFINERS, PHOTOGRAPHERS, STUDENTS, ETC. ETC.

By THOMAS BAYLEY, Assoc. R.C.Sc.I.
ANALYTICAL AND CONSULTING CHEMIST AND ASSAYER;
AUTHOR OF 'A POCKET-BOOK FOR PHARMACISTS,' 'THE ASSAY
AND ANALYSIS OF IRON AND STEEL, IRON ORES
AND FUEL,' ETC. ETC.

SEVENTH EDITION.
REVISED AND ENLARGED.

London:
E. & F. N. SPON, Ltd., 125 STRAND
New York:
SPON & CHAMBERLAIN, 12 CORTLANDT STREET
1900

25 Aug 53 [illegible] E. H. Webb

PREFACE

TO SEVENTH EDITION.

In issuing the seventh edition of the 'Chemists' Pocket-Book' I desire to proffer my thanks to the numerous chemists in all quarters of the English-speaking world who have from time to time written to me with reference to this little work. I also wish to express my appreciation of the manner in which the publishers have, without sparing trouble or expense, carried out the publication; and of the admirable way in which the highly-skilled readers of the firm have assisted me in the revision.

The present edition has been rearranged, and to a large extent rewritten; and I hope the labour expended upon it will serve to maintain it in the position of being the most widely used general collection of chemical memoranda in our language.

A few pages in the section on Analysis have been reprinted from the 'Pharmacist's Pocket-Book,' and in these, pharmaceutical forms, such as the extended use of capital letters and some contractions, will be found which will, I hope, be easily intelligible to chemists.

The book is not intended to teach anything (not even a system of ethics), and the various notes inserted here and there must be regarded merely as aids to memory.

Lastly, I wish to render thanks to the authors of the numerous works which I have made use of in the preparation of this rearranged edition.

THOMAS BAYLEY.

London, 1900.

CONTENTS.

SECTION I.—MATHEMATICAL.

Mathematical.

PAGE
Logarithms, 0 to 1000 1–8
Values of Squares, Cubes, Square Roots and Cube Roots, 1 to 100 9–12
Important Values of π 13
Areas and Volumes of Bodies 13
Areas of Circles in Gallons 15–23
Areas of Semi-Squares in Gallons .. 24–32

SECTION II.—ATOMIC WEIGHTS, ETC.

Atomic Weights.

Atomic Weights and Physical Properties 34–57
Classification of Elements 58–62
Multiples of Atomic Weights (with Logs) 63–65
Factors and Logarithms for use in Analysis 66–90
Chemical Calculations 91–93
(For Indirect Analysis, *see* p. 469.)

SECTION III.—WEIGHTS AND MEASURES.

Weights and Measures.

PAGE
Imperial System 94
Metric System 95
System of U.S.A. 96
Various Tables—Measures of Length, Weight, Surface, Volume, Capacity, Wine and Beer Measure &c. 97–103
Equivalence of Weights and Measures 103–107
Electrical and Heat Measurements .. 108–109
Conversion of Grams into Grains and *vice versâ* 110–117
Equivalent Rates per Lb., Cwt. & Ton 118
Decimal Equivalents of Pence and Shillings 118
Decimal Equivalents of Lb., Qrs., Cwts.; Lb., Oz. 119
Conversion of Percentage into Cwts. and Lb. per Ton, and Lb. per Cwt. 120–121
Conversion of Av. Oz. into Grains and Grams 122–136

SECT. IV.—THERMOMETRY, BAROMETRY, ETC.

Thermometry.

Comparison of ° C. with ° Fahr. .. 137–145
Comparison of ° R., ° C. and ° Fahr. 146–147
Comparison of Wedgwood Pyrometer with ° R. and ° C. 148
Correction of Thermometers in B.P. Determination 149
Comparison of Air and Mercurial Thermometers 150
Frigorific Mixtures 151, 152

Barometry.

PAGE
Comparison of British and Metrical Barometers 153–156
Correction of Barometers 157–160
Dew Point Tables 161–163

SECTION V.—SPECIFIC GRAVITY, HYDROMETRY AND SPECIFIC GRAVITY OF SOLUTIONS.

Specific Gravity.

Determination of Sp. Gr. 164–166
Sp. Gr. of Common Substances .. 166
See also p. 526
Hydrometers, Definition and Comparison of 167–172
Specific Gravity of Solutions 173–236

SECTION VI.—MELTING AND BOILING POINTS, SOLUBILITY.

M.P., B.P., Solubility.

M.P., B.P., Sp. Gr., Solubility, &c. of Substances 237–278
Solubility of Lead in Water 279
Solubility of Air in Water 280
Solubility of Gases in Water and Alcohol 281
B.P. of Saturated Solutions 282
M.P. of Substances 283
See also pp. 522–523
Behaviour of Organic Substances with Solvents 284–290

SECTION VII.—EUDIOMETRY.

Eudiometry.

PAGE
Reduction of Gaseous Volumes .. 292–293
Values of $760 \times (1 + \delta t)$ with logs 294–302
Values of $\frac{B}{760}$ with logs 303–305
Values of $\log \frac{\cdot 0012934}{760 (1 + \cdot 00367 t)}$ .. 306–307
Values of $\frac{1}{1 + \cdot 00367 T}$ 309
Table for Reduction of Volume to 0° C. 309–320
Table for Reduction of Volume to 760 mm. 321–332
Correction of Volume for Temperature 333–334
Correction of Volume for Pressure .. 335
Tension of Aqueous Vapour in mm. of Hg 336–340
Tension of Vapour of Hg 341
Dilation of Glass 341
Properties of Steam 342–343
Transformation of Water Pressure to Mercury Pressure 344
Expansion and Density of Water .. 345
Weight of 1 cm.^{3} of Air 346–347
Reduction of cm.^{3} of Nitrogen to Grams 348–349
Weight of 1 cm.^{3} Nitrogen 350–358
Weight of 1 cm.^{3} Carbonic Acid .. 359–360
Volume and Density of Water .. 361–362

SECTION VIII.—ANALYSIS.

Sub-Section A.

General Analysis.

PAGE

Reagents 363–370

Preliminary Testing for Common Substances 371–372

Behaviour of Metals with Borax Bead 373

Behaviour of Metals with a Bead of Microcosmic Salt 374

Examination of Solids in the Dry Way 375–378

Examination of Solutions in the Wet Way 378–381

Behaviour of Metals with Common Reagents 382–383

Examination for Acids 384–387

Characteristic Reactions of Acids .. 388

Colour Reactions 389–393

Examination of Animal Secretions, Calculi, Urine, Vomit, &c. 393–401

Detection of Vegetable Alkaloids .. 402

Sub-Section B.—Volumetric Analysis.

Volumetric Analysis.

Preparation of Indicators 403, 407

Indications given by various Indicators 404–406

Preparation of Standard Solutions, Factors and Notes for use 407–432

Table for Systematic Analysis of Alkalies 409

Table for Determination of Mixtures of Na_2CO_3 and K_2CO_3 412

Table for Determination of Mixtures of NaCl and KCl 413

Table for Conversion of N into NH_3 413

PAGE
Table for N in Kjeldahl's Method .. 413–414
Oxygen Dissolved by Distilled Water 426
Factors for Correcting the Cub. Cent. used when Standard Solutions vary from N or $\frac{N}{10}$ 433–440

Sub-Section C.—Water Analysis.

Water Analysis.

Reagents, Preparation of 441–444
Calculation of Results 443–446
Loss of N by Evaporation with Sulphurous or Metaphosphoric Acid 446–449
Table for N by Sprengel's Method .. 450
Tables of Hardness 451–453
Absorption of CO_2 by 5 cm.^{3} of HCl 454
Absorption of N in 60 cm.^{3} of Hypochlorite Solution 455

Sub-Section D.—Gas Analysis.

Gas Analysis.

Reagents, Preparation of 456
Tables for Estimation by Explosion .. 457
Formulæ for Calculation of Results 458–460
Table for Various Determinations with Nitrometer 461

Sub-Section E.—Dry Assaying.

Assaying.

Assay Tables for Lead Ores 462–463
Tables for Weight of Silver per ton of Ore 464–465
Conversion of Carats into Decimal Equivalents 466
Tables for Cupellation 467–468

Sub-Section F.

PAGE
Indirect Analysis 469–471

Sub-Section G.—Miscellaneous.

Chemical Manipulation 472–475

SECTION IX.—MINERALOGY.

Glossary of Important Minerals, with Formulæ, Hardness, S.G., &c. .. 476–481

SECTION X.—ALCOHOL.

Alcohol.

Determination of Alcohol 482–497
(1) By Strength of Alcohol by S.G. 483–489
(2) By Tralles' Tables. i. to x. .. 490–497
Correction of S.G. for Temperature 498
Boiling Points of Mixtures with Water 500

SECTION XI.—BEER.

Beer.

Lb. per Barrel, Degrees of Gravity; Standard Wort, Original Gravity, Definitions. &c. 501–503
Strength of Wort corresponding to Spirit Indication 503–504
Acidity of Beer 504
Salt in Beer 505
Spirit in Beer 506
S.G. and Strength of Malt Extract .. 507

SECTION XII.—SUGAR.

Sugar.

Saccharometry (Polarimetry) 508–513
Specific Rotatory Power of Sugars .. 509
S.G. of Solutions of Sugar 515–517
Fehling's Method, Factors for 518–519

SECTION XIII.—MISCELLANEOUS.

Miscellaneous.

Sub-Section A.—Physical.

PAGE
Linear Expansion of Substances .. 520
Variation of B.P. of Water for Pressure 521
Fusing Points of Substances 522–523
(*V.* p. 283.)
Tensions of Vapours of Liquefiable Gases 524
S.G. of Gases and Vapours 525

Sub-Section B.—Technical.

Weights of Substances 526
Speed of Currents of Air 527–530
Comparison of Alkalimetrical Degrees 531–532
Comparison of Chlorometrical Degrees 533
Proportion of Bases in Manganese Mud 534
Table for O in Residual Gases of Vitriol Chamber 535–536
Correction of S.G. of Milk for Temperature 537
Wages Table 538
Ready Reckoner 539
Old Names of Salts 540

SECTION XIV.—PHOTOGRAPHY 541–553

INDEX 554

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SECTION I.—MATHEMATICAL.

LOGARITHM OF NUMBERS FROM 0 TO 1200.

No.	0	1	2	3	4	5	6	7	8	9	Prop.
0	0	00000	30103	47712	60206	69897	77815	84510	90309	95424	
10	00000	00432	00860	01284	01703	02119	02531	02938	03342	03743	415
11	04139	04532	04922	05308	05690	06070	06746	06819	07188	07555	379
12	07918	08279	08636	08991	09342	09691	10037	10380	10721	11059	344
13	11394	11727	12057	12385	12710	13033	13354	13672	13988	14301	323
14	14613	14922	15229	15534	15836	16137	16435	16732	17026	17319	298
15	17609	17898	18184	18468	18752	19033	19312	19590	19866	20140	281
16	20412	20683	20952	21219	21484	21748	22011	22272	22531	22789	264
17	23045	23300	23553	23805	24055	24304	24551	24797	25042	25285	249
18	25527	25768	26007	26245	26482	26717	26951	27184	27416	27646	234
19	27875	28103	28330	28556	28780	29003	29226	29447	29667	29885	222
20	30103	30320	30535	30750	30963	31175	31387	31597	31806	32015	212
21	32222	32428	32634	32838	33041	33244	33445	33646	33846	34044	202
22	34242	34439	34635	34830	35025	35218	35411	35603	35793	35984	193
23	36173	36361	36549	36736	37922	37107	37291	37475	37658	37840	185
24	38021	38202	38382	38561	38739	38917	39094	39270	39445	39620	177
25	39794	39967	40140	40312	40483	40654	40824	40893	41162	41330	170

Indices of Logarithms :—
Log. 4030 = 3·60530
„ 403 = 2·60530

Log. 40·3 = 1·60530
„ 4·03 = ·60530
„ ·403 = $\bar{1}$·60530

Log. ·0403 = $\bar{2}$·60530
„ ·00403 = $\bar{3}$·60530

LOGARITHM OF NUMBERS FROM 0 TO 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
26	41497	41664	41830	41996	42160	42325	42488	42651	42813	42975	164
27	43136	43297	43457	43616	43775	43933	44091	44248	44404	44560	158
28	44716	44871	45025	45179	45332	45484	45637	45788	45939	46090	153
29	46240	46389	46538	46687	46835	46982	47129	47276	47422	47567	148
30	47712	47857	48001	48144	48287	48430	48572	48714	48855	48996	143
31	49136	49276	49415	49554	49693	49831	49969	50106	50243	50379	138
32	50515	50651	50786	50920	51055	51189	51322	51455	51587	51720	134
33	51851	51983	52114	52244	52375	52504	52634	52763	52892	53020	130
34	53148	53275	53403	53529	53656	53782	53908	54033	54158	54283	126
35	54407	54531	54654	54777	54900	55023	55145	55267	55388	55509	122
36	55630	55751	55871	55991	56110	56229	56348	56467	56585	56703	119
37	56820	56937	57054	57171	57287	57403	57519	57634	57749	57864	116
38	57978	58093	58206	58320	58433	58546	58659	58771	58883	58995	113
39	59106	59218	59329	59439	59550	59660	59770	59879	59988	60097	110
40	60206	60314	60423	60531	60638	60746	60853	60959	61066	61172	107

Find Log. of 5065
Log. of 5060 .. = 3·70415
Prop. 86 × Diff. 5 .. = 430

Log. required = 3·704580

LOGARITHM OF NUMBERS FROM 0 TO 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
41	61278	61384	61490	61595	61700	61805	61909	62014	62118	62221	104
42	62325	62428	62531	62634	62737	62839	62941	63043	63144	63246	102
43	63347	63448	63548	63649	63749	63849	63949	64048	64147	64246	99
44	64345	64444	64542	64640	64738	64836	64933	65031	65128	65225	98
45	65321	65418	65514	65610	65706	65801	65896	65992	66087	66181	96
46	66276	66370	66464	66558	66652	66745	66839	66932	67025	67117	95
47	67210	67302	67394	67486	67578	67669	67761	67852	67943	68034	92
48	68124	68215	68305	68395	68485	68574	68664	68753	68842	68931	90
49	69020	69108	69197	69285	69373	69461	69548	69636	69723	69810	88
50	69897	69984	70070	70157	70243	70329	70415	70501	70586	70672	86
51	70757	70842	70927	71012	71096	71181	71265	71349	71433	71517	84
52	71600	71684	71767	71850	71933	72016	72099	72181	72263	72346	82
53	72428	72509	72591	72673	72754	72835	72916	72997	73078	73159	81
54	73239	73320	73400	73480	73560	73640	73719	73799	73878	73957	80
55	74036	74115	74194	74273	74351	74429	74507	74586	74663	74741	78

Find number of Log. .. 3·771442
Log. of 5900 = 3·770850

Diff. 592 ÷ Prop. 73 = 8. Diff. = 592

No. required 5908

LOGARITHM OF NUMBERS FROM 0 TO 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
56	74819	74896	74974	75051	75128	75205	75282	75358	75435	75511	77
57	75587	75664	75740	75815	75891	75967	76042	76118	76193	76268	75
58	76343	76418	76492	76567	76641	76716	76790	76864	76938	77012	74
59	77085	77159	77232	77305	77379	77452	77525	77597	77670	77743	73
60	77815	77887	77960	78032	78104	78176	78247	78319	78390	78462	72
61	78533	78604	78675	78746	78817	78888	78958	79029	79099	79169	71
62	79239	79309	79379	79449	79518	79588	79657	79727	79796	79865	70
63	79934	80003	80072	80140	80209	80277	80346	80414	80482	80550	69
64	80618	80686	80754	80821	80889	80956	81023	81090	81158	81224	68
65	81291	81358	81425	81491	81558	81624	81690	81757	81823	81889	67
66	81954	82020	82086	82151	82217	82282	82347	82413	82478	82543	66
67	82607	82672	82737	82802	82866	82930	82995	83059	83123	83187	64
68	83251	83315	83378	83442	83506	83569	83632	83693	83759	83822	63
69	83885	83948	84011	84073	84136	84198	84261	84323	84386	84448	63
70	84510	84572	84634	84696	84757	84819	84880	84942	85003	85065	62

To multiply by logarithms add the logarithms together and find the corresponding number.
To divide by logarithms subtract one from the other.

Logarithm of Numbers from 0 to 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
71	85126	85187	85248	85309	85370	85431	85491	85552	85612	85673	61
72	85733	85794	85854	85914	85974	86034	86094	86153	86213	86273	60
73	86332	86392	86451	86510	86570	86629	86688	86747	86806	86864	59
74	86923	86982	87040	87099	87157	87216	87274	87332	87390	87448	58
75	87506	87564	87622	87680	87737	87795	87852	87910	87967	88024	57
76	88081	88138	88196	88252	88309	88366	88423	88480	88536	88593	57
77	88649	88705	88762	88818	88874	88930	88986	89042	89098	89154	56
78	89209	89265	89321	89376	89432	89487	89542	89597	89653	89708	55
79	89763	89818	89873	89927	89982	90037	90091	90146	90200	90255	54
80	90309	90363	90417	90472	90526	90580	90634	90687	90741	90795	54
81	90849	90902	90956	91009	91062	91116	91169	91222	91275	91328	53
82	91381	91434	91487	91540	91593	91645	91698	91751	91803	91855	53
83	91908	91960	92012	92065	92117	92169	92221	92273	92324	92376	52
84	92428	92480	92531	92583	92634	92686	92737	92788	92840	92891	51
85	92942	92993	93044	93095	93146	93197	93247	93298	93349	93399	51

To extract the root divide the logarithm by the index of the root and find the number corresponding to it.

To raise a number to any power multiply the logarithm by the index of the power and find the corresponding number.

LOGARITHM OF NUMBERS FROM 0 TO 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
86	93450	93500	93551	93601	93651	93702	93752	93802	93852	93902	50
87	93952	94002	94052	94101	94151	94201	94250	94300	94349	94399	49
88	94448	94498	94547	94596	94645	94694	94743	94792	94841	94890	49
89	94939	94988	95036	95085	95134	95182	95231	95279	95328	95376	48
90	95424	95472	95521	95569	95617	95665	95713	95761	95809	95856	48
91	95904	95952	95999	96047	96095	96142	96190	96237	96284	96332	48
92	96379	96426	96473	96520	96567	96614	96661	96708	96755	96802	47
93	96848	96895	96942	96988	97035	97081	97128	97174	97220	97267	47
94	97313	97359	97405	97451	97497	97543	97589	97635	97681	97727	46
95	97772	97818	97864	97909	97955	98000	98046	98091	98137	98182	46
96	98227	98272	98318	98363	98408	98453	98498	98543	98588	98632	45
97	98677	98722	98767	98811	98856	98900	98945	98989	99034	99078	45
98	99123	99167	99211	99255	99300	99344	99388	99432	99476	99520	44
99	99564	99607	99651	99695	99739	99782	99826	99870	99913	99957	44
100	00000	00043	00087	00130	00173	00217	90260	00303	00346	00389	43
101	00432	00475	00518	00561	00604	00647	00689	00732	00775	00817	43
102	00860	00903	00945	00988	01030	01072	01115	01175	01199	01242	42
103	01284	01326	01368	01410	01452	01494	01536	01578	01620	01662	42
104	01703	01745	01787	01828	01870	01912	01953	01995	02036	02078	42
105	02119	02160	02202	02243	02284	02325	02366	02407	02449	02490	41

Logarithm of Numbers from 0 to 1200—*continued.*

No.	0	1	2	3	4	5	6	7	8	9	Prop.
106	02531	02572	02612	02653	02694	02735	02776	02816	02857	02898	41
107	02938	02979	03019	03060	03100	03141	03181	03222	03262	03302	41
108	03342	03383	03423	03463	03503	03543	03583	03623	03663	03703	40
109	03743	03782	03822	03862	03902	03941	03981	04021	04060	04100	40
110	04139	04179	04218	04258	04297	04336	04376	04415	04454	04493	39
111	04532	04571	04610	04650	04689	04727	04766	04805	04844	04883	39
112	04922	04961	04999	05038	05077	05115	05154	05192	05231	05269	39
113	05308	05346	05385	05423	05461	05500	05538	05576	05614	05652	38
114	05690	05729	05767	05805	05843	05881	05918	05956	05994	06032	38
115	06070	06108	06145	06183	06221	06258	06296	06333	06371	06408	38
116	06446	06483	06521	06558	06595	06633	06670	06707	06744	06781	37
117	06819	06856	06893	06930	06967	07004	07041	07078	07115	07151	37
118	07188	07225	07262	07298	07335	07372	07408	07445	07482	07518	37
119	07555	07591	07628	07664	07700	07737	07773	07809	07846	07882	36

INVOLUTION AND EVOLUTION OF FRACTIONS BY LOGARITHMS.

In a logarithm the integer is called the *characteristic*, and the decimal portion the *mantissa*.

INVOLUTION.—The number carried from the *mantissa* to the *characteristic* being positive, must be deducted from the negative characteristic.

Example.—Find the 5th power of ·05, or the value of $\cdot 05^5$.

$$\text{Log. } \cdot 05 = \bar{2} \cdot 69897$$
$$\text{then } \bar{2} \times 5 = \overline{10}$$
$$+$$
$$\text{and } \cdot 69897 \times 5 = 3 \cdot 49485$$
$$\text{Then log. } \cdot 05^5 = 7 \cdot 49485$$
$$\text{and } \cdot 05^5 = \cdot 0000003125$$

EVOLUTION.—If the *negative* characteristic be not divisible without a remainder by the index of the required root, the number of units sufficient to make it so divisible must be added to it, and the same number of units must also be added to the mantissa before division.

Example.—Find the value of $\sqrt[5]{\cdot 0000003125}$.

$$\text{Log. } \cdot 0000003125 = 7 \cdot 49485$$
$$\text{then } 7 + \bar{3} = \overline{10}, \text{ and } \overline{10} \div 5 = \bar{2}$$
$$\text{and } 3 \cdot 49485 \div 5 = \cdot 69897$$
$$\text{Therefore log. } \sqrt[5]{\cdot 0000003125} = 2 \cdot 69897 = \text{log. of } \cdot 05.$$

PROPORTION BY LOGARITHMS.

Add together the logarithms of the 2nd and 3rd terms, and from their sum subtract the logarithm of the 1st term, then the number corresponding to the logarithm of the remainder gives the required answer.

Example.—68·30 : 13·70 : : 79·40.

$$\text{Log. } 13 \cdot 70 = 1 \cdot 13672$$
$$\text{Log. } 79 \cdot 40 = 1 \cdot 89982$$
$$\text{Sum } 3 \cdot 03654$$
$$\text{Log. } 68 \cdot 30 = 1 \cdot 83442$$
$$\text{Diff. } 1 \cdot 20212 = \text{log. of } 15 \cdot 93.$$

Values of Squares, Cubes, Square Roots, and Cube Roots of Numbers 1 to 100.

No.	Square.	Cube.	Square Root.	Cube Root.	No.	Square.	Cube.	Square Root.	Cube Root.
1	1	1	1·0	1·0	26	676	17576	5·09902	2·9625
2	4	8	1·41421	1·2599	27	729	19683	5·19615	3·0
3	9	27	1·73205	1·4422	28	784	21952	5·29150	3·0366
4	16	64	2·0	1·5874	29	841	24389	5·38516	3·0723
5	25	125	2·23607	1·7100	30	900	27000	5·47723	3·1072
6	36	216	2·44949	1·8171	31	961	29791	5·56776	3·1414
7	49	343	2·64575	1·9129	32	1024	32768	5·65685	3·1748
8	64	512	2·82843	2·0	33	1089	35937	5·74456	3·2075
9	81	729	3·0	2·0801	34	1156	39304	5·83095	3·2396
10	100	1000	3·16228	2·1544	35	1225	42875	5·91608	3·2711
11	121	1331	3·31662	2·2240	36	1296	46656	6·0	3·3019
12	144	1728	3·46410	2·2894	37	1369	50653	6·08276	3·3322
13	169	2197	3·60555	2·3513	38	1444	54872	6·16441	3·3620
14	196	2744	3·74166	2·4101	39	1521	59319	6·245	3·3912
15	225	3375	3·87298	2·4662	40	1600	64000	6·32456	3·4200
16	256	4096	4·0	2·5198	41	1681	68921	6·40312	3·4482
17	289	4913	4·12311	2·5713	42	1764	74088	6·48074	3·4760
18	324	5832	4·24264	2·6207	43	1849	79507	6·55744	3·5034
19	361	6859	4·35890	2·6684	44	1936	85184	6·63325	3·5303
20	400	8000	4·47214	2·7144	45	2025	91125	6·70820	3·5569
21	441	9261	4·58258	2·7589	46	2116	97336	6·78233	3·5830
22	484	10648	4·69042	2·8020	47	2209	103823	6·85565	3·6088
23	529	12167	4·79583	2·8439	48	2304	110592	6·92820	3·6342
24	576	13824	4·89898	2·8845	49	2401	117649	7·0	3·6593
25	625	15625	5·0	2·9240	50	2500	125000	7·07107	3·6840

VALUES OF SQUARES, CUBES, SQUARE ROOTS, ETC.—*continued.*

No.	Square.	Cube.	Square Root.	Cube Root.	No.	Square.	Cube.	Square Root.	Cube Root.
51	2601	132651	7·14143	3·7084	76	5776	438976	8·71780	4·2358
52	2704	140608	7·21110	3·7325	77	5929	456533	8·77496	4·2543
53	2809	148877	7·28011	3·7563	78	6084	474552	8·83176	4·2727
54	2916	157464	7·34847	3·7798	79	6241	493039	8·88819	4·2908
55	3025	166375	7·4162	3·8030	80	6400	512000	8·94427	4·3089
56	3136	175616	7·48331	3·8259	81	6561	531441	9·0	4·3267
57	3249	185193	7·54083	3·8485	82	6724	551368	9·05539	4·3445
58	3364	195112	7·61577	3·8709	83	6889	571787	9·11043	4·3621
59	3481	205379	7·68115	3·8930	84	7056	592704	9·16515	4·3795
60	3600	216000	7·74597	3·9149	85	7225	614125	9·21954	4·3968
61	3721	226981	7·81025	3·9365	86	7396	636056	9·27362	4·4140
62	3844	238328	7·87401	3·9579	87	7569	658503	9·32738	4·4310
63	3969	250047	7·93725	3·9791	88	7744	681472	9·38083	4·4480
64	4096	262144	8·0	4·0	89	7921	704969	9·43398	4·4647
65	4225	274625	8·06226	4·0207	90	8100	729000	9·48683	4·4814
66	4356	287496	8·12404	4·0412	91	8281	753571	9·53939	4·4979
67	4489	300763	8·18535	4·0615	92	8464	778688	9·59166	4·5144
68	4624	314432	8·24621	4·0817	93	8649	804357	9·64365	4·5307
69	4761	328509	8·30662	4·1016	94	8836	830584	9·69536	4·5468
70	4900	343000	8·36660	4·1213	95	9025	857375	9·74679	4·5629
71	5041	357911	8·42615	4·1408	96	9216	884736	9·79796	4·5789
72	5184	373248	8·48528	4·1602	97	9409	912673	9·84886	4·5947
73	5329	389017	8·54400	4·1793	98	9604	941192	9·89949	4·6104
74	5476	405224	8·60233	4·1983	99	9801	970299	9·94987	4·6261
75	5625	421875	8·66025	4·2172	100	10000	1000000	10·0	4·6416

VALUES OF $n\pi$ AND $n^2\frac{\pi}{4}$ FOR NUMBERS FROM 1 TO 100.

n	$n\pi$	$n^2\frac{\pi}{4}$	n	$n\pi$	$n^2\frac{\pi}{4}$	n	$n\pi$	$n^2\frac{\pi}{4}$
1·0	3·142	0·7854	13·5	42·412	143·14	26·0	81·681	530·93
1·5	4·712	1·7672	14·0	43·982	153·94	26·5	83·252	551·55
2·0	6·283	3·1416	14·5	45·553	165·13	27·0	84·823	572·56
2·5	7·854	4·9087	15·0	47·124	176·72	27·5	86·394	593·96
3·0	9·425	7·0686	15·5	48·695	188·69	28·0	87·965	615·75
3·5	10·996	9·6211	16·0	50·265	201·06	28·5	89·535	637·94
4·0	12·566	12·566	16·5	51·836	213·83	29·0	91·106	660·52
4·5	14·137	15·904	17·0	53·407	226·98	29·5	92·677	683·49
5·0	15·708	19·635	17·5	54·978	246·53	30·0	94·248	706·86
5·5	17·279	23·758	18·0	56·549	254·47	30·5	95·819	730·62
6·0	18·850	28·274	18·5	58·119	268·80	31·0	97·389	754·77
6·5	20·420	33·183	19·0	59·690	283·53	31·5	98·960	779·31
7·0	21·991	38·485	19·5	61·261	298·65	32·0	100·53	804·25
7·5	23·562	44·179	20·0	62·832	314·16	32·5	102·10	829·58
8·0	25·133	50·266	20·5	64·403	330·06	33·0	103·67	855·30
8·5	26·704	56·745	21·0	65·973	346·36	33·5	105·24	881·41
9·0	28·274	63·617	21·5	67·544	363·05	34·0	106·81	907·92
9·5	29·845	70·882	22·0	69·115	380·13	34·5	108·38	934·82
10·0	31·416	78·540	22·5	70·686	397·61	35·0	109·96	962·11
10·5	32·987	86·590	23·0	72·257	415·48	35·5	111·53	989·80
11·0	34·558	95·033	23·5	73·827	433·74	36·0	113·10	1017·88
11·5	36·128	103·87	24·0	75·398	452·39	36·5	114·67	1046·35
12·0	37·699	113·10	24·5	76·969	471·44	37·0	116·24	1075·21
12·5	39·270	122·72	25·0	78·540	490·87	37·5	117·81	1104·47
13·0	40·841	132·73	25·5	80·111	510·71	38·0	119·38	1134·11

VALUES OF $n\pi$ AND $n^2 \frac{\pi}{4}$ FOR NUMBERS FROM 1 TO 100—*continued.*

n	$n\pi$	$n^2 \frac{\pi}{4}$	n	$n\pi$	$n^2 \frac{\pi}{4}$	n	$n\pi$	$n^2 \frac{\pi}{4}$
38·5	120·95	1164·16	52·0	163·36	2123·72	77·0	241·90	4656·63
39·0	122·52	1194·59	53·0	166·50	2206·19	78·0	245·04	4778·37
39·5	124·09	1225·42	54·0	169·64	2290·22	79·0	248·18	4901·68
40·0	125·66	1256·64	55·0	172·78	2375·83	80·0	251·32	5026·56
40·5	127·23	1288·25	56·0	175·93	2463·01	81·0	254·47	5153·01
41·0	128·81	1320·25	57·0	179·07	2551·76	82·0	257·61	5281·03
41·5	130·38	1352·65	58·0	182·21	2642·08	83·0	260·75	5410·62
42·0	131·95	1385·44	59·0	185·35	2733·97	84·0	263·89	5541·78
42·5	133·52	1418·63	60·0	188·49	2827·44	85·0	267·03	5674·50
43·0	135·09	1452·20	61·0	191·63	2922·47	86·0	270·17	5808·81
43·5	136·66	1486·17	62·0	194·77	3019·07	87·0	273·32	5944·69
44·0	138·23	1520·53	63·0	197·92	3117·25	88·0	276·46	6082·13
44·5	139·80	1555·28	64·0	201·06	3216·99	89·0	279·60	6221·13
45·0	141·37	1590·43	65·0	204·20	3318·31	90·0	282·74	6361·74
45·5	142·94	1625·97	66·0	207·34	3421·20	91·0	285·88	6503·89
46·0	144·51	1661·90	67·0	210·48	3525·66	92·0	289·02	6647·62
46·5	146·08	1698·23	68·0	213·63	3631·69	93·0	292·17	6792·92
47·0	147·65	1734·94	69·0	216·77	3739·29	94·0	295·31	6939·78
47·5	149·23	1772·05	70·0	219·91	3848·46	95·0	298·45	7088·23
48·0	150·80	1809·56	71·0	223·05	3959·20	96·0	301·59	7238·24
48·5	152·37	1847·45	72·0	226·19	4071·51	97·0	304·73	7389·83
49·0	153·94	1885·74	73·0	229·33	4185·39	98·0	307·87	7542·98
49·5	155·51	1924·42	74·0	232·47	4300·85	99·0	311·02	7697·68
50·0	157·08	1963·50	75·0	235·62	4417·87	100·0	314·16	7854·00
51·0	160·22	2042·82	76·0	238·76	4536·47			

Important Values of π.

	Log.		Log.
$\pi = 3\cdot14159$	$0\cdot4971499''$	$\sqrt[3]{\pi} = 1\cdot46459$	$0\cdot1657160''$
$\frac{1}{\pi^2} = 0\cdot10132$	$\bar{1}\cdot0056952''$	$\frac{1}{\pi} = 0\cdot31831$	$\bar{1}\cdot5028503''$
$\pi^2 = 9\cdot8696$	$0\cdot9942996''$	$\sqrt{\frac{1}{\pi}} = 0\cdot54619$	$\bar{1}\cdot7373437''$
$\sqrt{\pi} = 1\cdot77245$	$0\cdot2485749''$	$\frac{\pi}{4} = 0\cdot785398$	$\bar{1}\cdot8950899'$
$\pi^3 = 31\cdot00628$	$1\cdot4914496''$	$\frac{\pi}{6} = 0\cdot52359$	$\bar{1}\cdot7189986''$

Areas and Volumes of Bodies.

Volume of rectangular vessel $= a\,b\,c$, where a, b and c are the three dimensions.

Area of triangle $= \frac{1}{2}$ base × height.

Area of circle $\frac{\pi}{4} d^2 = \pi r^2$. $r =$ radius. $\frac{\pi}{4} = 0\cdot7854$.

Area of ellipse = transverse axis × $\cdot7854$ × conjugate axis $= \pi\,a\,b$, where a and b are lengths of the two semi-axes.

Surface of sphere $= \pi d^2 = 4\,\pi r^2$. $d =$ diameter. $4\,\pi = 12\cdot5664$.

Surface of cylinder = area of both ends × length × diameter.

Surface of cone = area of base + circumference of base × $\frac{1}{2}$ slant height.

Volume of sphere $= \frac{4}{3}\pi r^3$. $\frac{4}{3}\pi = 4\cdot1888 = d^3 \times 0\cdot5236$, i.e. $\frac{\pi}{6} d^3$.

Volume of cylinder $= \pi r^2 h$. $r =$ radius of base. $h =$ height.

Volume of cone or pyramid = area of base × $\frac{1}{3}$ perpendicular height.

Volume of frustum of cone $= 0\cdot2618\,H\,(D^2 + d^2 + D\,d)$, where D and $d =$ diameters of each end, and H = perpendicular height.

Volume of cask considered as middle frustum of a prolate spheroid:

$$D = \sqrt{\frac{2\,B^2 + H^2}{3}}.$$

D = diam. of cylinder equal in volume and length to cask.
B = diam. at bung. H (or H^1) = diameter at head.

Or (approximately):

Ascertain the difference between B and H, and multiply it by ·7 (or ·68 if less than 6 inches); add the product to H to obtain diam. of required cylinder.

Or

$$\text{Capacity in gallons} = \cdot 0014162\ L\,(H\,H^1 + B^2).$$

L = length.

All the measurements are of course internal.

Physical.

To convert—

Degrees of Twaddle's hydrometer into S.G. (water=1000)—multiply by 5, and add 1000.

S.G. (water = 1000) into degrees Twaddle, subtract 1000, and divide by 5.

S.G., air = 1 to S.G., H = 1, multiply by 14·438.

S.G., H = 1 to S.G., air = 1, multiply by 0·06926.

Weight in air to weight in vacuo:—

P = weight required in vacuo.
q = weight in air.
V = volume of body weighed.
v = volume of the weights.
s = specific gravity of air (weight of one cubic unit).

$$P = q \times s\,(V - v).$$

Table showing the Areas of Circles in Imperial Gallons corresponding to Diameters in Imperial Inches.

By the area in gallons is meant the number of gallons which are contained by a cylinder having the circle as base, and a height of one inch. This table can be employed for calculating the area of ellipses, according to the formula Area $= \frac{a + \mathrm{B} - (a - \mathrm{B})}{2}$, where a is the area of the circle, having the transverse diameter of the ellipse as its diameter, B the area of corresponding circle for the congregate diameter, and $(a - \mathrm{B})$ the area of a circle having the difference between the transverse and congregate diameters as its diameter, the various diameters being expressed in inches.

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
1	·0028	·0034	·0040	·0047	·0055	·0063	·0072	·0081	·0091	·0102
2	·0113	·0124	·0137	·0149	·0163	·0177	·0191	·0206	·0222	·0238
3	·0254	·0272	·0290	·0308	·0327	·0346	·0367	·0387	·0409	·0430
4	·0453	·0476	·0499	·0523	·0548	·0573	·0599	·0625	·0652	·0680
5	·0708	·0736	·0765	·0795	·0825	·0856	·0888	·0920	·0952	·0986
6	·1019	·1053	·1088	·1124	·1160	·1196	·1233	·1271	·1309	·1348
7	·1387	·1427	·1468	·1509	·1551	·1593	·1636	·1679	·1723	·1767
8	·1812	·1858	·1904	·1951	·1998	·2046	·2094	·2143	·2193	·2243
9	·2294	·2345	·2397	·2449	·2502	·2556	·2610	·2665	·2720	·2776
10	·2832	·2889	·2947	·3005	·3063	·3122	·3182	·3243	·3303	·3365
11	·3427	·3490	·3553	·3616	·3681	·3746	·3811	·3877	·3944	·4011
12	·4078	·4147	·4215	·4285	·4355	·4425	·4496	·4568	·4640	·4713
13	·4787	·4860	·4935	·5010	·5086	·5162	·5239	·5316	·5394	·5472
14	·5551	·5631	·5711	·5792	·5873	·5955	·6037	·6120	·6204	·6288
15	·6373	·6458	·6544	·6630	·6717	·6805	·6893	·6982	·7071	·7161
16	·7251	·7342	·7433	·7525	·7618	·7711	·7805	·7899	·7994	·8090

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
17	·8186	·8282	·8379	·8477	·8575	·8674	·8774	·8874	·8974	·9075
18	·9177	·9279	·9382	·9485	·9589	·9694	·9799	·9905	1·0011	1·0118
19	1·0225	1·0333	1·0441	1·0551	1·0660	1·0770	1·0881	1·0992	1·1104	1·1217
20	1·1330	1·1443	1·1558	1·1672	1·1788	1·1903	1·2020	1·2137	1·2254	1·2372
21	1·2491	1·2610	1·2730	1·2851	1·2972	1·3093	1·3215	1·3338	1·3461	1·3585
22	1·3709	1·3834	1·3960	1·4086	1·4212	1·4339	1·4467	1·4595	1·4724	1·4854
23	1·4984	1·5114	1·5246	1·5377	1·5510	1·5642	1·5776	1·5910	1·6044	1·6179
24	1·6315	1·6451	1·6588	1·6726	1·6863	1·7002	1·7141	1·7281	1·7421	1·7562
25	1·7703	1·7845	1·7987	1·8131	1·8274	1·8418	1·8563	1·8708	1·8854	1·9001
26	1·9148	1·9295	1·9443	1·9592	1·9741	1·9891	2·0042	2·0193	2·0344	2·0496
27	2·0649	2·0802	2·0956	2·1110	2·1265	2·1421	2·1577	2·1734	2·1891	2·2049
28	2·2207	2·2366	2·2525	2·2685	2·2846	2·3007	2·3169	2·3331	2·3494	2·3657
29	2·3821	2·3986	2·4151	2·4317	2·4483	2·4650	2·4817	2·4985	2·5154	2·5323
30	2·5473	2·5663	2·5834	2·6005	2·6177	2·6349	2·6523	2·6696	2·6870	2·7045
31	2·7221	2·7396	2·7573	2·7750	2·7928	2·8106	2·8284	2·8464	2·8644	2·8824
32	2·9005	2·9187	2·9369	2·9551	2·9735	2·9919	3·0103	3·0288	3·0473	3·0660
33	3·0846	3·1033	3·1221	3·1410	3·1599	3·1788	3·1978	3·2169	3·2360	3·2552
34	3·2744	3·2937	3·3130	3·3324	3·3519	3·3714	3·3910	3·4106	3·4303	3·4500
35	3·4698	3·4897	3·5096	3·5296	3·5496	3·5697	3·5898	3·6100	3·6303	3·6506
36	3·6710	3·6914	3·7119	3·7324	3·7530	3·7736	3·7943	3·8151	3·8359	3·8568
37	3·8777	3·8987	3·9198	3·9409	3·9620	3·9833	4·0045	4·0259	4·0472	4·0687
38	4·0902	4·1117	4·1334	4·1550	4·1767	4·1985	4·2204	4·2423	4·2642	4·2862
39	4·3083	4·3304	4·3526	4·3748	4·3971	4·4195	4·4419	4·4643	4·4869	4·5094

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
40	4·5321	4·5548	4·5775	4·6003	4·6232	4·6461	4·6690	4·6921	4·7152	4·7383
41	4·7615	4·7848	4·8081	4·8314	4·8549	4·8783	4·9019	4·9255	4·9491	4·9728
42	4·9966	5·0204	5·0443	5·0682	5·0922	5·1163	5·1404	5·1645	5·1888	5·2130
43	5·2374	5·2618	5·2862	5·3107	5·3353	5·3599	5·3846	5·4093	5·4341	5·4589
44	5·4838	5·5088	5·5338	5·5588	5·5840	5·6091	5·6344	5·6597	5·6850	5·7104
45	5·7359	5·7614	5·7870	5·8126	5·8383	5·8641	5·8899	5·9157	5·9417	5·9676
46	5·9937	6·0198	6·0459	6·0721	6·0984	6·1247	6·1510	6·1775	6·2040	6·2305
47	6·2571	6·2838	6·3105	6·3372	6·3641	6·3909	6·4179	6·4449	6·4719	6·4990
48	6·5262	6·5534	6·5807	6·6080	6·6354	6·6629	6·6904	6·7179	6·7455	6·7732
49	6·8010	6·8287	6·8566	6·8845	6·9124	6·9405	6·9685	6·9967	7·0248	7·0531
50	7·0814	7·1097	7·1381	7·1666	7·1951	7·2237	7·2524	7·2810	7·3098	7·3386
51	7·3675	7·3964	7·4254	7·4544	7·4835	7·5126	7·5418	7·5711	7·6004	7·6298
52	7·6592	7·6887	7·7183	7·7479	7·7775	7·8072	7·8370	7·8668	7·8967	7·9266
53	7·9566	7·9867	8·0168	8·0470	8·0772	8·1075	8·1378	8·1682	8·1987	8·2292
54	8·2597	8·2903	8·3210	8·3518	8·3825	8·4134	8·4443	8·4753	8·5063	8·5373
55	8·5685	8·5997	8·6309	8·6622	8·6936	8·7250	8·7564	8·7880	8·8196	8·8512
56	8·8829	8·9146	8·9465	8·9783	9·0102	9·0422	9·0743	9·1064	9·1385	9·1707
57	9·2030	9·2353	9·2677	9·3001	9·3326	9·3651	9·3977	9·4304	9·4631	9·4959
58	9·5287	9·5616	9·5945	9·6275	9·6606	9·6937	9·7269	9·7601	9·7934	9·8267
59	9·8601	9·8936	9·9271	9·9607	9·9943	10·0280	10·0617	10·0955	10·1293	10·1632
60	10·1972	10·2312	10·2653	10·2994	10·3336	10·3679	10·4022	10·4365	10·4709	10·5054
61	10·5399	10·5745	10·6092	10·6439	10·6786	10·7134	10·7483	10·7832	10·8182	10·8533
62	10·8884	10·9235	10·9587	10·9940	11·0293	11·0647	11·1001	11·1356	11·1712	11·2068

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
63	11·2424	11·2781	11·3139	11·3497	11·3856	11·4216	11·4576	11·4936	11·5298	11·5659
64	11·6022	11·6384	11·6748	11·7112	11·7476	11·7842	11·8207	11·8573	11·8940	11·9308
65	11·9676	12·0044	12·0413	12·0783	12·1153	12·1524	12·1895	12·2267	12·2640	12·3013
66	12·3386	12·3760	12·4135	12·4511	12·4886	12·5263	12·5640	12·6017	12·6396	12·6774
67	12·7154	12·7533	12·7914	12·8295	12·8676	12·9058	12·9441	12·9824	13·0208	13·0593
68	13·0978	13·1363	13·1749	13·2136	13·2523	13·2911	13·3299	13·3688	13·4078	13·4468
69	13·4858	13·5249	13·5641	13·6033	13·6426	13·6820	13·7214	13·7608	13·8003	13·8399
70	13·8795	13·9192	13·9590	13·9988	14·0386	14·0785	14·1185	14·1585	14·1986	14·2387
71	14·2789	14·3192	14·3595	14·3999	14·4403	14·4808	14·5213	14·5619	14·6025	14·6432
72	14·6840	14·7248	14·7657	14·8066	14·8476	14·8886	14·9297	14·9709	15·0121	15·0534
73	15·0947	15·1361	15·1775	15·2190	15·2606	15·3022	15·3439	15·3856	15·4274	15·4692
74	15·5111	15·5531	15·5951	15·6371	15·6792	15·7214	15·7637	15·8059	15·8483	15·8907
75	15·9332	15·9757	16·0182	16·0609	16·1036	16·1463	16·1891	16·2320	16·2749	16·3179
76	16·3609	16·4040	16·4471	16·4903	16·5336	16·5769	16·6202	16·6637	16·7071	16·7507
77	16·7943	16·8379	16·8816	16·9254	16·9692	17·0131	17·0570	17·1010	17·1450	17·1891
78	17·2333	17·2775	17·3218	17·3661	17·4105	17·4550	17·4995	17·5440	17·5886	17·6333
79	17·6780	17·7228	17·7676	17·8125	17·8575	17·9025	17·9476	17·9927	18·0379	18·0831
80	18·1284	18·1738	18·2192	18·2646	18·3101	18·3557	18·4013	18·4470	18·4928	18·5386
81	18·5844	18·6304	18·6763	18·7224	18·7684	18·8146	18·8608	18·9070	18·9534	18·9997
82	19·0462	19·0926	19·1392	19·1858	19·2324	19·2791	19·3259	19·3727	19·4196	19·4665
83	19·5135	19·5606	19·6077	19·6548	19·7021	19·7493	19·7967	19·8441	19·8915	19·9390
84	19·9866	20·0342	20·0819	20·1296	20·1774	20·2252	20·2731	20·3211	20·3691	20·4171
85	20·4653	20·5135	20·5617	20·6100	20·6583	20·7067	20·7552	20·8037	20·8523	20·9096

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
86	20·9496	20·9984	21·0472	21·0961	21·1450	21·1940	21·2430	21·2921	21·3412	21·3904
87	21·4397	21·4890	21·5384	21·5878	21·6373	21·6868	21·7364	21·7861	21·8358	21·8856
88	21·9354	21·9853	22·0352	22·0852	22·1352	22·1854	22·2355	22·2857	22·3360	22·3863
89	22·4367	22·4872	22·5377	22·5883	22·6389	22·6895	22·7403	22·7911	22·8419	22·8928
90	22·9438	22·9948	23·0459	23·0970	23·1482	23·1994	23·2507	23·3021	23·3535	23·4049
91	23·4565	23·5080	23·5597	23·6114	23·6631	23·7149	23·7668	23·8187	23·8707	23·9227
92	23·9748	24·0270	24·0792	24·1314	24·1838	24·2361	24·2886	24·3411	24·3936	24·4462
93	24·4989	24·5516	24·6043	24·6572	24·7100	24·7630	24·8160	24·8690	24·9222	24·9753
94	25·0285	25·0818	25·1352	25·1886	25·2420	25·2955	25·3491	25·4027	25·4564	25·5101
95	25·5639	25·6177	25·6717	25·7256	25·7796	25·8337	25·8878	25·9420	25·9963	26·0506
96	26·1049	26·1593	26·2138	26·2683	26·3229	26·3776	26·4323	26·4870	26·5418	26·5967
97	26·6516	26·7066	26·7616	26·8167	26·8719	26·9271	26·9823	27·0377	27·0930	27·1485
98	27·2040	27·2595	27·3151	27·3708	27·4265	27·4823	27·5381	27·5940	27·6499	27·7059
99	27·7620	27·8181	27·8743	27·9305	27·9868	28·0431	28·0995	28·1560	28·2125	28·2690
100	28·3257	28·3823	28·4391	28·4959	28·5527	28·6096	28·6666	28·7236	28·7807	28·8378
101	28·8950	28·9522	29·0096	29·0669	29·1243	29·1818	29·2393	29·2969	29·3546	29·4123
102	29·4700	29·5278	29·5857	29·6436	29·7016	29·7596	29·8177	29·8759	29·9341	29·9924
103	30·0507	30·1091	30·1675	30·2260	30·2845	30·3432	30·4018	30·4605	30·5193	30·5781
104	30·6370	30·6960	30·7550	30·8140	30·8732	30·9323	30·9916	31·0508	31·1102	31·1696
105	31·2290	31·2886	31·3481	31·4077	31·4674	31·5272	31·5870	31·6468	31·7067	31·7667
106	31·8267	31·8868	31·9469	32·0071	32·0674	32·1277	32·1880	32·2485	32·3089	32·3695
107	32·4301	32·4907	32·5514	32·6122	32·6730	32·7338	32·7948	32·8558	32·9168	32·9779
108	33·0391	33·1003	33·1615	33·2229	33·2842	33·3457	33·4072	33·4687	33·5303	33·5920

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
109	33·6537	33·7155	33·7773	33·8392	33·9012	33·9632	34·0252	34·0874	34·1495	34·2118
110	34·2741	34·3364	34·3988	34·4613	34·5238	34·5863	34·6490	34·7117	34·7744	34·8372
111	34·9001	34·9630	35·0259	35·0890	35·1520	35·2152	35·2784	35·3416	35·4049	35·4683
112	35·5317	35·5952	35·6587	35·7223	35·7860	35·8497	35·9134	35·9772	36·0411	36·1051
113	36·1690	36·2331	36·2972	36·3613	36·4256	36·4898	36·5542	36·6185	36·6830	36·7475
114	36·8120	36·8766	36·9413	37·0060	37·0708	37·1357	37·2006	37·2655	37·3305	37·3956
115	37·4607	37·5259	37·5911	37·6564	37·7217	37·7871	37·8526	37·9181	37·9837	38·0493
116	38·1150	38·1808	38·2466	38·3124	38·3783	38·4443	38·5103	38·5764	38·6426	38·7088
117	38·7750	38·8413	38·9077	38·9741	39·0406	39·1071	39·1737	39·2404	39·3071	39·3738
118	39·4407	39·5075	39·5745	39·6415	39·7085	39·7756	39·8428	39·9100	39·9773	40·0446
119	40·1120	40·1794	40·2469	40·3145	40·3821	40·4498	40·5175	40·5853	40·6531	40·7210
120	40·7890	40·8570	40·9250	40·9932	41·0613	41·1296	41·1979	41·2662	41·3346	41·4031
121	41·4716	41·5402	41·6088	41·6775	41·7463	41·8151	41·8839	41·9528	42·0218	42·0908
122	42·1599	42·2291	42·2983	42·3675	42·4368	42·5062	42·5756	42·6451	42·7147	42·7843
123	42·8539	42·9236	42·9934	43·0632	43·1331	43·2030	43·2730	43·3431	43·4132	43·4833
124	43·5536	43·6238	43·6942	43·7646	43·8350	43·9055	43·9761	44·0467	44·1173	44·1881
125	44·2589	44·3297	44·4006	44·4716	44·5426	44·6136	44·6848	44·7560	44·8272	44·8985
126	44·9698	45·0412	45·1127	45·1842	45·2558	45·3275	45·3991	45·4709	45·5427	45·6146
127	45·6865	45·7585	45·8305	45·9026	45·9747	46·0469	46·1192	46·1915	46·2639	46·3363
128	46·4088	46·4813	46·5539	46·6266	46·6993	46·7721	46·8449	46·9178	46·9907	47·0637
129	47·1368	47·2099	47·2830	47·3563	47·4295	47·5029	47·5763	47·6497	47·7232	47·7968
130	47·8704	47·9441	48·0178	48·0916	48·1654	48·2393	48·3133	48·3873	48·4614	48·5355
131	48·6097	48·6839	48·7582	48·8326	48·9070	48·9815	49·0560	49·1306	49·2052	49·2799

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*cotinued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
132	49·3547	49·4295	49·5043	49·5793	49·6542	49·7293	49·8014	49·8795	49·9547	50·0300
133	50·1053	50·1807	50·2561	50·3316	50·4071	50·4827	50·5584	50·6341	50·7099	50·7857
134	50·8616	50·9375	51·0135	51·0896	51·1657	51·2419	51·3181	51·3944	51·4707	51·5471
135	51·6235	51·7001	51·7766	51·8532	51·9299	52·0067	52·0834	52·1603	52·2372	52·3142
136	52·3912	52·4682	52·5454	52·6226	52·6998	52·7771	52·8545	52·9319	53·0094	53·0869
137	53·1645	53·2421	53·3198	53·3976	53·4754	53·5532	53·6312	53·7091	53·7872	53·8653
138	53·9434	54·0216	54·0999	54·1782	54·2566	54·3350	54·4135	54·4921	54·5707	54·6493
139	54·7280	54·8068	54·8856	54·9645	55·0435	55·1225	55·2015	55·2807	55·3598	55·4390
140	55·5183	55·5977	55·6771	55·7565	55·8360	55·9156	55·9952	56·0749	56·1546	56·2344
141	56·3143	56·3942	56·4742	56·5542	56·6343	56·7144	56·7946	56·8748	56·9551	57·0355
142	57·1159	57·1964	57·2769	57·3575	57·4381	57·5188	57·5996	57·6804	57·7613	57·8422
143	57·9232	58·0042	58·0853	58·1665	58·2477	58·3290	58·4103	58·4917	58·5731	58·6546
144	58·7361	58·8177	58·8994	58·9811	59·0629	59·1447	59·2266	59·3086	59·3906	59·4726
145	59·5547	59·6369	59·7191	59·8014	59·8838	59·9662	60·0486	60·1311	60·2137	60·2963
146	60·3790	60·4618	60·5446	60·6274	60·7103	60·7933	60·8763	60·9594	61·0425	61·1257
147	61·2090	61·2923	61·3756	61·4591	61·5425	61·6261	61·7097	61·7933	61·8770	61·9608
148	62·0446	62·1284	62·2124	62·2964	62·3804	62·4645	62·5487	62·6329	62·7171	62·8015
149	62·8858	62·9703	63·0548	63·1393	63·2239	63·3086	63·3933	63·4781	63·5629	63·6478
150	63·7328	63·8178	63·9029	63·9880	64·0731	64·1584	64·2437	64·3290	64·4144	64·4999
151	64·5854	64·6710	64·7566	64·8423	64·9280	65·0138	65·0997	65·1856	65·2716	65·3576
152	65·4437	65·5298	65·6160	65·7022	65·7886	65·8749	65·9613	66·0478	66·1344	66·2209
153	66·3076	66·3943	66·4811	66·5679	66·6548	66·7417	66·8287	66·9157	67·0028	67·0900
154	67·1772	67·2645	67·3518	67·4392	67·5266	67·6141	67·7017	67·7893	67·8770	67·9647

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
155	68·0525	68·1403	68·2282	68·3161	68·4041	68·4922	68·5803	68·6685	68·7567	68·8450
156	68·9334	69·0218	69·1103	69·1988	69·2873	69·3760	69·4647	69·5534	69·6422	69·7311
157	69·8200	69·9090	69·9980	70·0871	70·1762	70·2654	70·3547	70·4440	70·5333	70·6228
158	70·7122	70·8018	70·8914	70·9810	71·0707	71·1605	71·2503	71·3402	71·4301	71·5201
159	71·6102	71·7003	71·7904	71·8806	71·9709	72·0613	72·1516	72·2421	72·3326	72·4231
160	72·5138	72·6044	72·6952	72·7859	72·8768	72·9677	73·0586	73·1496	73·2407	73·3318
161	73·4230	73·5142	73·6055	73·6969	73·7883	73·8798	73·9713	74·0629	74·1545	74·2462
162	74·3379	74·4297	74·5216	74·6135	74·7055	74·7975	74·8896	74·9817	75·0739	75·1662
163	75·2585	75·3509	75·4433	75·5358	75·6283	75·7209	75·8136	75·9063	75·9991	76·0919
164	76·1848	76·2777	76·3707	76·4637	76·5569	76·6500	76·7432	76·8365	76·9298	77·0232
165	77·1167	77·2102	77·3037	77·3974	77·4910	77·5848	77·6786	77·7724	77·8663	77·9603
166	78·0543	78·1483	78·2425	78·3366	78·4309	78·5252	78·6195	78·7139	78·8084	78·9029
167	78·9975	79·0921	79·1868	79·2816	79·3764	79·4713	79·5662	79·6612	79·7562	79·8513
168	79·9464	80·0416	80·1369	80·2322	80·3276	80·4230	80·5185	80·6140	80·7096	80·8053
169	80·9010	80·9968	81·0926	81·1885	81·2844	81·3804	81·4765	81·5726	81·6687	81·7650
170	81·8612	81·9576	82·0540	82·1504	82·2469	82·3435	82·4401	82·5368	82·6335	82·7303
171	82·8271	82·9240	83·0210	83·1180	83·2151	83·3122	83·4094	83·5067	83·6039	83·7013
172	83·7987	83·8962	83·9937	84·0913	84·1889	84·2866	84·3844	84·4822	84·5801	84·6780
173	84·7760	84·8740	84·9721	85·0702	85·1684	85·2667	85·3650	85·4634	85·5618	85·6603
174	85·7589	85·8575	85·9561	86·0548	86·1536	86·2524	86·3513	86·4503	86·5493	86·6483
175	86·7474	86·8466	86·9458	87·0451	87·1444	87·2438	87·3433	87·4428	87·5424	87·6420
176	87·7417	87·8414	87·9412	88·0410	88·1409	88·2409	88·3409	88·4410	88·5411	88·6413
177	88·7416	88·8419	88·9422	89·0426	89·1431	89·2436	89·3442	89·4449	89·5455	89·6463

AREAS OF CIRCLES IN IMPERIAL GALLONS FROM DIAMETERS—*continued.*

Diam. in Ins.	0	1	2	3	4	5	6	7	8	9
178	89·7471	89·8480	89·9489	90·0499	90·1509	90·2520	90·3532	90·4544	90·5556	90·6570
179	90·7583	90·8598	90·9613	91·0628	91·1644	91·2661	91·3678	91·4696	91·5714	91·6733
180	91·7752	91·8772	91·9793	92·0814	92·1836	92 2858	92·3881	92·4904	92·5928	92·6953
181	92·7978	92·9004	93·0030	93·1057	93·2084	93·3112	93·4140	93·5170	93·6199	93·7229
182	93·8260	93·9292	94·0323	94·1356	94·2389	94·3423	94·4457	94·5491	94·6527	94·7563
183	94·8599	94·9636	95·0674	95·1712	95·2750	95·3790	95·4830	95·5870	95·6911	95·7952
184	95·8995	96·0037	96·1080	96·2124	96·3169	96·4214	96·5259	96·6305	96·7352	96·8399
185	96·9447	97·0495	97·1544	97·2593	97·3644	97·4694	97·5745	97·6797	97·7849	97·8902
186	97·9956	98·1010	98·2064	98·3119	98·4175	98·5231	98·6288	98·7345	98·8403	98·9462
187	99·0521	99·1581	99·2641	99·3702	99·4763	99·5825	99·6888	99·7951	99·9014	100·0078
188	100·1143	100·2209	100·3274	100·4341	100·5408	100·6476	100·7544	100·8612	100·9682	101·0752
189	101·1822	101·2893	101·3965	101·5037	101·6109	101·7183	101·8256	101·9331	102·0406	102·1481
190	102·2557	102·3634	102·4711	102·5789	102·6868	102·7946	102·9026	103·0106	103·1187	103·2268
191	103·3350	103·4432	103·5515	103·6598	103·7682	103·8767	103·9852	104·0938	104·2024	104·3111
192	104·4198	104·5286	104·6375	104·7464	104·8554	104·9644	105·0735	105·1826	105·2918	105·4011
193	105·5104	105·6197	105·7292	105·8386	105·9482	106·0578	106·1674	106·2771	106·3869	106·4967
194	106·6066	106·7165	106·8265	106·9365	107·0466	107·1568	107·2670	107·3773	107·4876	107·5980
195	107·7084	107·8189	107·9294	108·0401	108·1508	108·2615	108·3723	108·4831	108·5940	108·7050
196	108·8160	108·9270	109·0382	109·1493	109·2606	109·3719	109·4832	109·5946	109·7061	109·8176
197	109·9292	110·0408	110·1525	110·2642	110·3760	110·4879	110·5998	110·7118	110·8238	110·9359
198	111·0480	111·1602	111·2725	111·3848	111·4972	111·6096	111·7221	111·8346	111·9472	112·0599
199	112·1726	112·2853	112·3982	112·5110	112·6240	112·7370	112·8500	112·9631	113·0763	113·1895
200	113·3028	113·4161	113·5295	113·6429	113·7564	113·8700	113·9836	114·0973	114·2110	114·3248

Table Showing the Areas of Semi-Squares in Imperial Gallons corresponding to Sides in Imperial Inches.

This table shows the number of gallons contained in a prism having the semi-square described on the side as base, and a height of one inch. It is of use in finding the area in gallons of a rectangle. The area is $a \times b$, a and b being the sides of the rectangle. But

$$a\,b = \frac{a^2}{2} + \frac{b^2}{2} - \frac{(a-b)^2}{2}.$$

Rules.—Add the area of the semi-square on the longer side of the rectangle to the area of the semi-square on the shorter side, and from the sum deduct the semi-square on a line equal to the difference between the two sides, dimensions being in inches.

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
		·00002	·00007	·00016	·00029	·00045	·00065	·00088	·00115	·00146
1	·0018	·0022	·0026	·0030	·0035	·0041	·0046	·0052	·0058	·0065
2	·0072	·0080	·0087	·0095	·0104	·0113	·0122	·0131	·0141	·0152
3	·0162	·0173	·0185	·0196	·0208	·0221	·0234	·0247	·0260	·0274
4	·0289	·0303	·0318	·0333	·0349	·0365	·0382	·0398	·0415	·0433
5	·0451	·0469	·0488	·0507	·0526	·0545	·0566	·0586	·0607	·0628
6	·0649	·0671	·0693	·0716	·0739	·0762	·0786	·0809	·0834	·0859
7	·0884	·0909	·0935	·0961	·0987	·1014	·1042	·1069	·1097	·1125
8	·1154	·1183	·1213	·1242	·1272	·1303	·1334	·1365	·1396	·1428
9	·1461	·1493	·1526	·1560	·1593	·1627	·1662	·1697	·1732	·1767
10	·1803	·1840	·1876	·1913	·1950	·1988	·2026	·2065	·2103	·2142
11	·2182	·2222	·2262	·2303	·2344	·2385	·2426	·2468	·2511	·2554
12	·2597	·2640	·2684	·2728	·2773	·2818	·2863	·2908	·2954	·3001
13	·3048	·3095	·3142	·3190	·3238	·3286	·3335	·3385	·3434	·3484
14	·3534	·3585	·3636	·3688	·3739	·3791	·3844	·3897	·3950	·4003
15	·4057	·4112	·4166	·4221	·4277	·4332	·4388	·4445	·4502	·4559
16	·4616	·4674	·4733	·4791	·4850	·4909	·4969	·5029	·5090	·5150

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
17	·5211	·5273	·5335	·5397	·5460	·5523	·5586	·5649	·5713	·5778
18	·5843	·5908	·5973	·6039	·6105	·6172	·6239	·6306	·6373	·6441
19	·6510	·6579	·6648	·6717	·6787	·6857	·6927	·6998	·7070	·7141
20	·7213	·7285	·7358	·7431	·7504	·7578	·7652	·7727	·7802	·7877
21	·7952	·8028	·8105	·8181	·8258	·8336	·8413	·8491	·8570	·8649
22	·8728	·8807	·8887	·8967	·9048	·9129	·9210	·9292	·9374	·9457
23	·9539	·9622	·9706	·9790	·9874	·9959	1·0043	1·0129	1·0214	1·0300
24	1·0387	1·0474	1·0561	1·0648	1·0736	1·0824	1·0913	1·1002	1·1091	1·1180
25	1·1270	1·1361	1·1451	1·1543	1·1634	1·1726	1·1818	1·1910	1·2003	1·2097
26	1·2190	1·2284	1·2378	1·2473	1·2568	1·2663	1·2759	1·2855	1·2952	1·3049
27	1·3146	1·3243	1·3341	1·3440	1·3538	1·3637	1·3737	1·3836	1·3936	1·4037
28	1·4138	1·4239	1·4340	1·4442	1·4544	1·4647	1·4750	1·4853	1·4957	1·5061
29	1·5166	1·5270	1·5375	1·5481	1·5587	1·5693	1·5800	1·5906	1·6014	1·6121
30	1·6229	1·6338	1·6447	1·6556	1·6665	1·6775	1·6885	1·6996	1·7107	1·7218
31	1·7329	1·7441	1·7554	1·7666	1·7780	1·7893	1·8007	1·8121	1·8235	1·8350
32	1·8465	1·8581	1·8697	1·8813	1·8930	1·9047	1·9164	1·9282	1·9400	1·9519
33	1·9638	1·9757	1·9876	1·9996	2·0117	2·0237	2·0358	2·0480	2·0601	2·0723
34	2·0846	2·0969	2·1092	2·1215	2·1339	2·1463	2·1588	2·1713	2·1838	2·1964
35	2·2090	2·2216	2·2343	2·2470	2·2598	2·2726	2·2854	2·2983	2·3111	2·3241
36	2·3370	2·3500	2·3631	2·3762	2·3893	2·4024	2·4156	2·4288	2·4421	2·4554
37	2·4687	2·4820	2·4954	2·5089	2·5223	2·5358	2·5494	2·5630	2·5766	2·5902
38	2·6039	2·6176	2·6314	2·6452	2·6590	2·6729	2·6868	2·7007	2·7147	2·7287
39	2·7428	2·7569	2·7710	2·7851	2·7993	2·8136	2·8278	2·8421	2·8565	2·8708

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
40	2·8852	2·8997	2·9142	2·9287	2·9432	2·9578	2·9724	2·9871	3·0018	3·0165
41	3·0313	3·0461	3·0609	3·0758	3·0907	3·1057	3·1207	3·1357	3·1507	3·1658
42	3·1810	3·1961	3·2113	3·2266	3·2418	3·2572	3·2725	3·2879	3·3033	3·3188
43	3·3342	3·3498	3·3653	3·3809	3·3966	3·4122	3·4279	3·4437	3·4595	3·4753
44	3·4911	3·5070	3·5229	3·5389	3·5549	3·5709	3·5870	3·6031	3·6192	3·6354
45	3·6516	3·6679	3·6842	3·7005	3·7168	3·7332	3·7496	3·7661	3·7826	3·7991
46	3·8157	3·8323	3·8490	3·8657	3·8824	3·8991	3·9159	3·9327	3·9496	3·9665
47	3·9834	4·0004	4·0174	4·0344	4·0515	4·0686	4·0858	4·1030	4·1202	4·1374
48	4·1547	4·1721	4·1894	4·2068	4·2243	4·2417	4·2593	4·2768	4·2944	4·3120
49	4·3297	4·3473	4·3651	4·3828	4·4006	4·4185	4·4363	4·4542	4·4722	4·4902
50	4·5082	4·5262	4·5443	4·5624	4·5806	4·5988	4·6170	4·6353	4·6536	4·6719
51	4·6903	4·7087	4·7272	4·7456	4·7642	4·7827	4·8013	4·8199	4·8386	4·8573
52	4·8760	4·8948	4·9136	4·9325	4·9513	4·9703	4·9892	5·0082	5·0272	5·0463
53	5·0654	5·0845	5·1037	5·1229	5·1421	5·1614	5·1807	5·2001	5·2195	5·2389
54	5·2583	5·2778	5·2974	5·3169	5·3365	5·3562	5·3758	5·3955	5·4153	5·4351
55	5·4549	5·4747	5·4946	5·5146	5·5345	5·5545	5·5746	5·5946	5·6147	5·6349
56	5·6551	5·6753	5·6955	5·7158	5·7361	5·7565	5·7769	5·7973	5·8178	5·8383
57	5·8588	5·8794	5·9000	5·9207	5·9413	5·9621	5·9828	6·0036	6·0244	6·0453
58	6·0662	6·0871	6·1081	6·1291	6·1502	6·1712	6·1924	6·2135	6·2347	6·2559
59	6·2772	6·2985	6·3198	6·3412	6·3626	6·3840	6·4055	6·4270	6·4486	6·4702
60	6·4918	6·5134	6·5351	6·5569	6·5786	6·6004	6·6223	6·6441	6·6660	6·6880
61	6·7100	6·7320	6·7540	6·7761	6·7983	6·8204	6·8426	6·8649	6·8871	6·9094
62	6·9318	6·9542	6·9766	6·9990	7·0215	7·0440	7·0666	7·0892	7·1118	7·1345

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
63	7·1572	7·1799	7·2027	7·2255	7·2484	7·2712	7·2942	7·3171	7·3401	7·3631
64	7·3862	7·4093	7·4324	7·4556	7·4788	7·5021	7·5253	7·5487	7·5720	7·5954
65	7·6188	7·6423	6·6658	7·6893	7·7129	7·7365	7·7601	7·7838	7·8075	7·8313
66	7·8550	7·8789	7·9027	7·9266	7·9505	7·9745	7·9985	8·0226	8·0466	8·0707
67	8·0949	8·1191	8·1433	8·1675	8·1918	8·2162	8·2405	8·2649	8·2893	8·3138
68	8·3383	8·3629	8·3874	8·4121	8·4367	8·4614	8·4861	8·5109	8·5357	8·5605
69	8·5854	8·6103	8·6352	8·6602	8·6852	8·7102	8·7353	8·7604	8·7856	8·8108
70	8·8360	8·8613	8·8866	8·9119	8·9373	8·9627	8·9881	9·0136	9·0391	9·0647
71	9·0903	9·1159	9·1416	9·1673	9·1930	9·2188	9·2446	9·2704	9·2963	9·3222
72	9·3482	9·3741	9·4002	9·4262	9·4523	9·4784	9·5046	9·5308	9·5570	9·5833
73	9·6096	9·6360	9·6624	9·6888	9·7152	9·7417	9·7682	9·7948	9·8214	9·8480
74	9·8747	9·9014	9·9282	9·9549	9·9818	10·0086	10·0355	10·0624	10·0894	10·1164
75	10·1434	10·1705	10·1976	10·2247	10·2519	10·2791	10·3063	10·3336	10·3609	10·3883
76	10·4157	10·4431	10·4706	10·4981	10·5256	10·5532	10·5808	10·6084	10·6361	10·6638
77	10·6916	10·7194	10·7472	10·7751	10·8030	10·8309	10·8589	10·8869	10·9149	10·9430
78	10·9711	10·9992	11·0274	11·0557	11·0839	11·1122	11·1405	11·1689	11·1973	11·2257
79	11·2542	11·2827	11·3113	11·3398	11·3685	11·3971	11·4258	11·4545	11·4833	11·5121
80	11·5409	11·5698	11·5987	11·6276	11·6566	11·6856	11·7147	11·7438	11·7729	11·8021
81	11·8313	11·8605	11·8898	11·9191	11·9484	11·9778	12·0072	12·0366	12·0661	12·0956
82	12·1252	12·1548	12·1844	12·2141	12·2438	12·2735	12·3033	12·3331	12·3629	12·3928
83	12·4227	12·4527	12·4827	12·5127	12·5428	12·5729	12·6030	12·6332	12·6634	12·6936
84	12·7239	12·7542	12·7845	12·8149	12·8453	12·8758	12·9063	12·9368	12·9674	12·9980
85	13·0286	13·0593	13·0900	13·1208	13·1515	13·1824	13·2132	13·2441	13·2750	13·3060

Areas of Semi-Squares in Imperial Gallons—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
86	13·3370	13·3680	13·3991	13·4302	13·4613	13·4925	13·5237	13·5550	13·5863	13·6176
87	13·6490	13·6803	13·7118	13·7432	13·7747	13·8063	13·8379	13·8695	13·9011	13·9328
88	13·9645	13·9963	14·0281	14·0599	14·0918	14·1237	14·1556	14·1876	14·2196	14·2516
89	14·2837	14·3158	14·3480	14·3802	14·4124	14·4446	14·4769	14·5093	14·5416	14·5740
90	14·6065	14·6390	14·6715	14·7040	14·7366	14·7692	14·8019	14·8346	14·8673	14·9001
91	14·9329	14·9657	14·9986	15·0315	15·0644	15·0974	15·1304	15·1635	15·1966	15·2297
92	15·2629	15·2961	15·3293	15·3626	15·3959	15·4292	15·4626	15·4960	15·5295	15·5630
93	15·5965	15·6300	15·6636	15·6973	15·7309	15·7646	15·7984	15·8322	15·8660	15·8998
94	15·9337	15·9676	16·0016	16·0356	16·0696	16·1037	16·1378	16·1719	16·2061	16·2403
95	16·2745	16·3088	16·3431	16·3775	16·4119	16·4463	16·4807	16·5152	16·5498	16·5843
96	16·6189	16·6536	16·6883	16·7230	16·7577	16·7925	16·8273	16·8622	16·8971	16·9320
97	16·9670	17·0020	17·0370	17·0721	17·1072	17·1423	17·1775	17·2127	17·2480	17·2833
98	17·3186	17·3540	17·3894	17·4248	17·4603	17·4958	17·5313	17·5669	17·6025	17·6382
99	17·6739	17·7096	17·7453	17·7811	17·8170	17·8528	17·8887	17·9247	17·9606	17·9967
100	18·0327	18·0688	18·1049	18·1411	18·1773	18·2135	18·2497	18·2860	18·3224	18·3588
101	18·3952	18·4316	18·4681	18·5046	18·5412	18·5777	18·6144	18·6510	18·6877	18·7245
102	18·7612	18·7980	18·8349	18·8717	18·9087	18·9456	18·9826	19·0196	19·0567	19·0938
103	19·1309	19·1681	19·2053	19·2425	19·2798	19·3171	19·3544	19·3918	19·4292	19·4667
104	19·5042	19·5417	19·5793	19·6169	19·6545	19·6922	19·7299	19·7676	19·8054	19·8432
105	19·8811	19·9189	19·9569	19·9948	20·0328	20·0709	20·1089	20·1470	20·1852	20·2233
106	20·2615	20·2998	20·3381	20·3764	20·4148	20·4531	20·4916	20·5300	20·5685	20·6071
107	20·6456	20·6843	20·7229	20·7616	20·8003	20·8390	20·8778	20·9167	20·9555	20·9944
108	21·0333	21·0723	21·1113	21·1504	21·1894	21·2286	21·2677	21·3069	21·3461	21·3854

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
109	21·4247	21·4640	21·5034	21·5428	21·5822	21·6217	21·6612	21·7007	21·7403	21·7799
110	21·8196	21·8593	21·8990	21·9388	21·9785	22·0184	22·0583	22·0982	22·1381	22·1781
111	22·2181	22·2581	22·2982	22·3384	22·3785	22·4187	22·4589	22·4992	22·5395	22·5798
112	22·6202	22·6606	22·7011	22·7416	22·7821	22·8226	22·8632	22·9039	22·9445	22·9852
113	23·0260	23·0667	23·1075	23·1484	23·1893	23·2302	23·2711	23·3121	23·3531	23·3942
114	23·4353	23·4764	23·5176	23·5588	23·6000	23·6413	23·6826	23·7240	23·7654	23·8068
115	23·8483	23·8897	23·9313	23·9728	24·0144	24·0561	24·0978	24·1395	24·1812	24·2230
116	24·2648	24·3067	24·3486	24·3905	24·4324	24·4744	24·5165	24·5585	24·6006	24·6428
117	24·6850	24·7272	24·7694	24·8117	24·8540	24·8964	24·9388	24·9812	25·0237	25·0662
118	25·1087	25·1513	25·1939	25·2366	25·2793	25·3220	25·3647	25·4075	25·4503	25·4932
119	25·5361	25·5790	25·6220	25·6650	25·7081	25·7512	25·7943	25·8374	25·8806	25·9238
120	25·9671	26·0104	26·0537	26·0971	26·1405	26·1839	26·2274	26·2709	26·3145	26·3581
121	26·4017	26·4453	26·4890	26·5328	26·5765	26·6203	26·6642	26·7080	26·7519	26·7959
122	26·8399	26·8839	26·9279	26·9720	27·0162	27·0603	27·1045	27·1488	27·1930	27·2373
123	27·2817	27·3261	27·3705	27·4149	27·4594	27·5039	27·5485	27·5931	27·6377	27·6824
124	27·7271	27·7718	27·8166	27·8614	27·9063	27·9511	27·9961	28·0410	28·0860	28·1310
125	28·1761	28·2212	28·2663	28·3115	28·3567	28·4020	28·4472	28·4926	28·5379	28·5833
126	28·6287	28·6742	28·7197	28·7652	28·8108	28·8564	28·9020	28·9477	28·9934	29·0392
127	29·0849	29·1308	29·1766	29·2225	29·2684	29·3144	29·3604	29·4065	29·4525	29·4986
128	29·5448	29·5910	29·6372	29·6834	29·7297	29·7761	29·8224	29·8688	29·9152	29·9617
129	30·0082	30·0548	30·1013	30·1480	30·1946	30·2413	30·2880	30·3348	30·3816	30·4284
130	30·4753	30·5222	30·5691	30·6161	30·6631	30·7101	30·7572	30·8043	30·8515	30·8987
131	30·9459	30·9932	31·0405	31·0878	31·1352	31·1826	31·2300	31·2775	31·3250	31·3726

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
132	31·4202	31·4678	31·5155	31·5632	31·6109	31·6587	31·7065	31·7543	31·8022	31·8501
133	31·8981	31·9460	31·9941	32·0421	32·0902	32·1383	32·1865	32·2347	32·2829	32·3312
134	32·3795	32·4279	32·4763	32·5247	32·5731	32·6216	32·6701	32·7187	32·7673	32·8159
135	32·8646	32·9133	32·9621	33·0108	33·0596	33·1085	33·1574	33·2063	33·2553	33·3043
136	33·3533	33·4024	33·4515	33·5006	33·5498	33·5990	33·6482	33·6975	33·7468	33·7962
137	33·8456	33·8950	33·9445	33·9940	34·0435	34·0931	34·1427	34·1923	34·2420	34·2917
138	34·3415	34·3913	34·4411	34·4910	34·5409	34·5908	34·6408	34·6908	34·7408	34·7909
139	34·8410	34·8911	34·9413	34·9915	35·0418	35·0921	35·1424	35·1928	35·2432	35·2936
140	35·3441	35·3946	35·4452	35·4957	35·5464	35·5970	35·6477	35·6984	35·7492	35·8000
141	35·8508	35·9017	35·9526	36·0035	36·0545	36·1055	36·1566	36·2077	36·2588	36·3099
142	36·3611	36·4124	36·4636	36·5149	36·5663	36·6177	36·6691	36·7205	36·7720	36·8235
143	36·8751	36·9267	36·9783	37·0300	37·0817	37·1334	37·1852	37·2370	37·2888	37·3407
144	37·3926	37·4446	37·4966	37·5486	37·6006	37·6527	37·7049	37·7570	37·8092	37·8615
145	37·9138	37·9661	38·0184	38·0708	38·1232	38·1757	38·2282	38·2807	38·3333	38·3859
146	38·4385	38·4912	38·5439	38·5966	38·6494	38·7022	38·7551	38·8080	38·8609	38·9139
147	38·9669	39·0199	39·0730	39·1261	39·1792	39·2324	39·2856	39·3389	39·3922	39·4455
148	39·4988	39·5522	39·6057	39·6591	39·7126	39·7662	39·8197	39·8734	39·9270	39·9807
149	40·0344	40·0882	40·1420	40·1958	40·2496	40·3035	40·3575	40·4115	40·4655	40·5195
150	40·5736	40·6277	40·6819	40·7360	40·7903	40·8445	40·8988	40·9532	41·0075	41·0619
151	41·1164	41·1708	41·2254	41·2799	41·3345	41·3891	41·4438	41·4985	41·5532	41·6080
152	41·6628	41·7176	41·7725	41·8274	41·8823	41·9373	41·9923	42·0474	42·1025	42·1576
153	42·2128	42·2680	42·3232	42·3785	42·4338	42·4891	42·5445	42·5999	42·6554	42·7108
154	42·7664	42·8219	42·8775	42·9331	42·9888	43·0445	43·1003	43·1560	43·2118	43·2677

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
155	43·3236	43·3795	43·4354	43·4914	43·5475	43·6035	43·6596	43·7158	43·7719	43·8281
156	43·8844	43·9407	43·9970	44·0533	44·1097	44·1661	44·2226	44·2791	44·3356	44·3922
157	44·4488	44·5055	44·5621	44·6188	44·6756	44·7324	44·7892	44·8461	44·9029	44·9599
158	45·0168	45·0738	45·1309	45·1880	45·2451	45·3022	45·3594	45·4166	45·4739	45·5312
159	45·5885	45·6458	45·7032	45·7607	45·8181	45·8757	45·9332	45·9908	46·0484	46·1060
160	46·1637	46·2214	46·2792	46·3370	46·3948	46·4527	46·5106	46·5685	46·6265	46·6845
161	46·7426	46·8007	46·8588	46·9169	46·9751	47·0333	47·0916	47·1499	47·2082	47·2666
162	47·3250	47·3835	47·4420	47·5005	47·5590	47·6176	47·6762	47·7349	47·7936	47·8523
163	47·9111	47·9699	48·0287	48·0876	48·1465	48·2055	48·2645	48·3235	48·3825	48·4416
164	48·5008	48·5599	48·6191	48·6784	48·7376	48·7969	48·8563	48·9157	48·9751	49·0345
165	49·0940	49·1536	49·2131	49·2727	49·3324	49·3920	49·4517	49·5115	49·5713	49·6311
166	49·6909	49·7508	49·8107	49·8707	49·9307	49·9907	50·0508	50·1109	50·1710	50·2312
167	50·2914	50·3517	50·4119	50·4723	50·5326	50·5930	50·6534	50·7139	50·7744	50·8349
168	50·8955	50·9561	51·0168	51·0774	51·1382	51·1989	51·2597	51·3205	51·3814	51·4423
169	51·5032	51·5642	51·6252	51·6862	51·7473	51·8084	51·8696	51·9307	51·9920	52·0532
170	52·1145	52·1758	52·2372	52·2986	52·3600	52·4215	52·4830	52·5446	52·6062	52·6678
171	52·7294	52·7911	52·8528	52·9146	52·9764	53·0382	53·1001	53·1620	53·2240	53·2859
172	53·3480	53·4100	53·4721	53·5342	53·5964	53·6586	53·7208	53·7831	53·8454	53·9077
173	53·9701	54·0325	54·0949	54·1574	54·2199	54·2825	54·3451	54·4077	54·4704	54·5331
174	54·5958	54·6586	54·7214	54·7842	54·8471	54·9100	54·9730	55·0360	55·0990	55·1621
175	55·2252	55·2883	55·3515	55·4147	55·4779	55·5412	55·6045	55·6678	55·7312	55·7946
176	55·8581	55·9216	55·9851	56·0487	56·1123	56·1759	56·2396	56·3033	56·3671	56·4308
177	56·4947	56·5585	56·6224	56·6863	56·7503	56·8143	56·8783	56·9424	57·0065	57·0706

AREAS OF SEMI-SQUARES IN IMPERIAL GALLONS—*continued.*

Sides in Ins.	0	1	2	3	4	5	6	7	8	9
178	57·1348	57·1990	57·2633	57·3276	57·3919	57·4563	57·5206	57·5851	57·6495	57·7140
179	57·7786	57·8432	57·9078	57·9724	58·0371	58·1018	58·1666	58·2314	58·2962	58·3611
180	58·4260	58·4909	58·5559	58·6209	58·6859	58·7510	58·8161	58·8813	58·9465	59·0117
181	59·0769	59·1422	59·2076	59·2729	59·3383	59·4038	59·4693	59·5348	59·6003	59·6659
182	59·7315	59·7972	59·8629	59·9286	59·9944	60·0602	60·1260	60·1919	60·2578	60·3237
183	60·3897	60·4557	60·5218	60·5879	60·6540	60·7202	60·7864	60·8526	60·9189	60·9852
184	61·0515	61·1179	61·1843	61·2508	61·3173	61·3838	61·4503	61·5169	61·5836	61·6502
185	61·7169	61·7837	61·8504	61·9173	61·9841	62·0510	62·1179	62·1849	62·2519	62·3189
186	62·3859	62·4530	62·5202	62·5874	62·6546	62·7218	62·7891	62·8564	62·9238	62·9911
187	63·0586	63·1260	63·1935	63·2611	63·3286	63·3962	63·4639	63·5315	63·5993	63·6670
188	63·7348	63·8026	63·8705	63·9384	64·0063	64·0743	64·1423	64·2103	64·2784	64·3465
189	64·4146	64·4828	64·5510	64·6193	64·6876	64·7559	64·8243	64·8927	64·9611	65·0296
190	65·0981	65·1666	65·2352	65·3038	65·3724	65·4411	65·5099	65·5786	65·6474	65·7162
191	65·7851	65·8540	65·9229	65·9919	66·0609	66·1300	66·1991	66·2682	66·3373	66·4065
192	66·4758	66·5450	66·6143	66·6837	66·7530	66·8224	66·8919	66·9614	67·0309	67·1004
193	67·1700	67·2396	67·3093	67·3790	67·4487	67·5185	67·5883	67·6581	67·7280	67·7979
194	67·8679	67·9379	68·0079	68·0779	68·1480	68·2182	68·2883	68·3585	68·4288	68·4990
195	68·5694	68·6397	68·7101	68·7805	68·8510	68·9214	68·9920	69·0625	69·1331	69·2038
196	69·2744	69·3451	69·4159	69·4867	69·5575	69·6283	69·6992	69·7701	69·8411	69·9121
197	69·9831	70·0542	70·1253	70·1964	70·2676	70·3388	70·4101	70·4813	70·5527	70·6240
198	70·6954	70·7668	70·8383	70·9098	70·9813	71·0529	71·1245	71·1962	71·2678	71·3396
199	71·4113	71·4831	71·5549	71·6268	71·6987	71·7706	71·8426	71·9146	71·9866	72·0587
200	72·1308	72·2030	72·2752	72·3474	72·4196	72·4919	72·5643	72·6366	72·7090	72·7815

SECTION II.

ATOMIC WEIGHTS.

CLASSIFICATION OF ELEMENTS:

- Newlands-Mendelejeff Table.
- Arrangement in Double Periods (Mendelejeff).
- Cyclic System (Bayley).

FACTORS AND THEIR LOGARITHMS.

CHEMICAL CALCULATIONS.

Table of the Elements, showing—Equivalents or Combining Weights (Eq.); Atomic Weight Specific Gravity (S.G.); Atomic Volume $\left(= \text{specific vol.} = \text{A.V.} = \frac{\text{A.W.}}{\text{S.G.}}\right)$; Melting Point Coefficient of Expansion for Heat (Linear) (C.E.); Physical State, &c. (H = hard, M = malleable,

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
Aluminium **Al**	9·007	**27·02**	—	·2253 at 0° to 100°	6·1	$\frac{4^\circ}{4^\circ}$ (fused) 2·583
Antimony **Sb**	40	**120**	—	·0523	6·2	$\frac{\text{c. }15^\circ}{4^\circ}$ 6·697
				·0495 at 0° to 100°	5·9	Melted 6·53
				·048 at −21° to 0°	5·8	6·65
				·047 at −75° to −21°	5·6	6·71 to 6·86
Arsenic **As**	24·97	**74·9**	299·6 (As_4)	·083 crys.	6·2	$\frac{14^\circ}{14^\circ}$ 5·727 pure crys.
				·076 amorph.	5·7	$\frac{14^\circ}{14^\circ}$ 4·71 grey crys.
						$\frac{14^\circ}{14^\circ}$ 4·713 amorph.
						$\frac{19^\circ}{19^\circ}$ 5·709 fused
Barium **Ba**	68·4	**136·8**	—	..	..	c. 3·5 to 4

(A.W., H = 1); Molecular Weight (M.W.); Specific Heat (S.H.); Atomic Heat (A.H. = S.H. × A.W.); (M.P. [° C.]); Boiling Point (B.P. (° C.)); Electrical Conductivity (E.C.); Thermal Conductivity (T.C.); S = soft, D = ductile, B = brittle). The A.W.'s are those adopted in Watts' 'Dictionary of Chemistry.'

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
10·4	[654·5°]	—	20·97 at 0° 16·15 at 15°	31·33	·00002336 at 50°	Tin white metal, M, D.
..	..	..	2·05 at 0°	4·03	·00001152 at 40°	Silver-white metal-like, B, H.
17·9	..	Between (1090° and 1450°).	1·42 at 100°			Isomorph. with As.
..	[629·5°]					
13·1 crys.	Only under great pressure.	..	2·679 at 0°	..	·00000559 at 40°	*Crystn.* hexag. rhombohed. B, steel-grey, *amorph.*
15·9 amorph.	[450°]	..	1·873 at 100°			
c. 36·5	..	..	..	..	..	Metal, little known.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H. × A.W.	S.G.
BERYLLIUM **Be**	4·54	**9·08**	—	·4702 at 100° ·540 at 200° ·6206 at 500°	4·3 4·9 5·6	$\frac{20^\circ}{20^\circ}$ 1·85 after compression.
BISMUTH **Bi**	69·33	**208**	—	·0305 at 20° to 48°	6·5	$\frac{4^\circ}{4^\circ}$ 9·759 10·0 liqd. at M.P.
BORON **B**	3·66	**10·97**	—	·1915 at − 40° ·2737 at × 77° ·3378 at 177° ·3663 at 233 (·5 at 1000) (?) crystal. impure? B	2·11 3·01 3·72 4·03 (5·5)	2·53–2·68
BROMINE **Br**	79·75	**79·75**	159·5 (Br_2)	·08432 at −78° to 20° ..	6·7 ..	$\frac{0}{4}$ 3·18828 $\frac{59{\cdot}27^\circ}{\cdot}$ 2·9822
CADMIUM **Cd**	55·85	**111·7**	111·7 (Cd)	·0548 at 0° to 100° ·0567	6·1 6·3	Molten 8·65 Hamd. 8·8
CÆSIUM **Cs**	132·7	**132·7**	..	Not determined	..	$\frac{15^\circ}{\cdot}$ 1·88
CALCIUM **Ca**	19·95	**39·91**	..	·1686 at 0° to 100°	6·7	1·82

Elements—*continued.*

A.V.	M.P. [°C.]	B.P. (°C).	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100	C.E. lin. at °C.	Physical State.
4·92	..	..	..	..	..	Metal, hexag. holohedral, steel coloured.
20·8	[268·3°]	(1090°–1450°)	·8676 at 0°	1·8	·00001316 at 0°–100°	White (red tinge) metal, hexagonal, B.
4·1	Very infusible.	..	..	..	..	*Amorphous* (greenish brown) *Crystalline* (contg. Al ?)
25	[−7 2°]	(59·27°)	..	..	..	Non-metallic.
26·7	[−7·05°	(58·7°)				Brown liquid.
13·03	[320°] ..	(763°–772°) ..	13·46 at 0° 9·5 at 100°	20·06	·00003323 at 0°–100°	White (blue tinge) metal, S, M, D.
70·6	[26°–27°]	..	..	..	..	White metal, D.
21·6	760°	..	12·5	25·4	..	White (yell. tinge) metal, M, D.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
CARBON C	2·99	11·97	..	·0635 at −50° ·4589 at 985° } Dia.	0·76 5·51	Diamond $\frac{4^\circ}{4^\circ}$ 3·518
				·1138 at −50° ·467 at 978° } Grap.	1·37 5·50	Graphite 2·11–2·26
				·2385 at 0° to 223° m.	2·84	Amorph. 1·45–1·7
CERIUM Ce	46·6	139·9	..	·0448 at 0° to 100°	6·3	$\underline{\text{c. }18}$ 6·63–6·73
CHLORINE Cl	35·37	35·37	70·74	(S.H.v. ·0928)	(3·2)	Liq. 1·33
CHROMIUM Cr	26·22	52·45	..	·0998 at 22° to 50°	5·2	6·5–6·8
COBALT Co	29·4	58·8	..	·107	6·3	8·5–8·9
COPPER Cu	31·6	63·2	..	·0933 at 15° to 100° ·0948 at 16° to 172° ·0968	.. 6·0	8·36–8·95
DIDYMIUM Di	47·66	c. 143*	..	·04563	6·5	6·5
ERBIUM Er	55·33	166				

* Separable into Praseodymium, A.W. 143·6, and Neodymium, A.W. 140·8. *V.* p. 61.

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100	C.E. lin. at °C.	Physical State.
3·4	Never fused.	..	·082 (graph.).	..	·00000118 at 40° (diam.).	*Diamond*, octahed. *Graphite*, hexag. *Amorphous.*
(>6)						
20·8	..	..	..	..	..	Steel-grey metal, M, D.
26·6	[− 102°]	(−33·6°, 760 m.)	..	..	..	Yellow gas.
7·71	Above 2500	..	..	..	..	Greyish-white metal, octahed., H, B.
c. 6·84	c. 1500	..	9·685 at 0°	17·2	..	White metal, H.
7·06	[1080·5°]	..	.. 52–54 at 0°	73·6	·00001666 at 0°–100°	Red metal, cubes and octahed., M, D.
c. 23·5	..	..	..	..	..	White metal, M, D.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
FLUORINE **F**	19	**19**	..	..	..	..
GALLIUM **Ga**	23	**69·9**	..	·079 at 12° to 23° ·0802 liquid	5·4	$\frac{24\cdot5}{24\cdot5}$ 5·96
GERMANIUM **Ge**	18·08	**72·32**	..	·077 at 0° to 200°	5·6	$\frac{20\cdot4}{20\cdot4}$ 5·469
GOLD **Au**	65·57	**196·7**	..	·0316 at 0° to 100° ·03244 at 12° to 98°	.. 6·4	$\frac{17\cdot5}{17\cdot5}$ 19·3
HYDROGEN **H**	1	**1**	2	..	..	c. ·07
INDIUM **In**	37·8	**113·4**	..	·05695 at 0° to 100°	6·5	$\frac{20\cdot4}{}$ 7·11–7·147 $\frac{15}{\cdot}$ 7·362 $\frac{16\cdot8}{\cdot}$ 7·421

ELEMENTS—*continued.*

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
..	..	..	..	..	..	Colourless gas.
11·7	[30·15°]	..	..	..	..	Grey metal, octahed.
13·2	[c. 900°]	..	..	..	..	Greyish-white metal, octahed., B.
10·2	[1061·7°]	..	43·84 to 44·62 at 0°	53·2	·00001443, at 40° ·0000147 at 0°–100°	Yellow metal, octahed. and dodecahed., M,S,D.
c. 14·3 at B.P.	[c. –256·3°]	(–252°)	..	..	..	Colourless gas.
15·3	[176°]	..	..	..	·0000459 at 0°–100°	Silver-white metal, S,D. Non-crystalline.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
Iodine **I**	126·53	**126·53**	253·06	·05412 at 9° to 98°	6·8	$\frac{40\cdot3}{\cdot}$ 4·917 $\frac{107}{\cdot}$ 4·825
Iridium **Ir**	48·125	**192·5**	..	·0323 at 0° to 100° ·0401 at 0° to 1400°	6·2	$\frac{17\cdot5}{\cdot}$ 22·42
Iron **Fe**	27·95	**55·9**	..	·111641 at 0° ·113795 at 100°	6·2	c. 8
Lanthanum **La**	46·07	**138·2**	..	·04485	6·2	6·163
Lead **Pb**	103·2	**206·4**	206·4?	·03065 at −78° to 11°	..	$\frac{0}{\cdot}$ 11·35
				·0315 at 19° to 48°	6·5	$\frac{4}{\cdot}$ 11·35
				·0402 at 340° to 450°	..	Molten 10·37–10·65
Lithium **Li**	7·01	**7·01**	7·01?	·9408 at 27° to 100°	6·6	·578–·589
Magnesium **Mg**	12	**24**	24?	·245 at 20° to 51°	5·9	$\frac{17}{\cdot}$ 1·69–1·71

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
25·8	[114·15°]	(184·35)	..	..	..	Greyish-black solid, non-metallic.
8·6	[1950°] [2200°] [2500°]	..	..	..	·000007	White lustrous metal, B.
c. 7	[1550°] [1600°]	..	9·68 at 0° 6·19 at 100°	11·9	·00001233 at 13°–100°	Greyish-white metal, M, D. Cubes or octah.
22·4	[450°–950°]	..	..	..	..	White metal, M, D.
18·2	[330°–335°]	(1450°–1600°)	4·8 at 0°	8·5	·00002799 at 0°–100°	Almost white metal, octahed., M, D, S.
	[326]°		3·363 at 100°			
11·9	[180°]	..	10·69 at 20°	..	..	Silver-white metal, D.
14·0	[632·7°]	..	22·84 at 0° 16·34 at 100°	34·3	·00002694 at 40°	Silver-white metal, hexagonal, M, D.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
MANGANESE **Mn**	27·5	**55**	55?	·1217 at 14° to 97° (Impure sample)	6·7	6·85–8·01 $\frac{22}{\cdot}$ 7·39
MERCURY **Hg**	99·9	**199·8**	199·8	·0319	6·4	$\frac{0}{4}$ 13·596
				·03312 at 20° to 50°	..	$\frac{20}{4}$ 13·546
				·03278 at 25° to 142°	..	$\frac{-38·85}{4}$ 14·1932
MOLYBDENUM **Mo**	19·18	**95·9**	..	·0659 at 5° to 15°	6·3	8·56 8·49–8·64
NICKEL **Ni**	29·3	**58·6**	..	·10916 at 14° to 97°	6·4	8·97–9·26
NIOBIUM **Nb**	31·33	**94**	..	..	..	$\frac{15·5}{\cdot}$ 7·06
NITROGEN **N**	4·67	**14·01**	28·02	S.H.p. ·2368	..	$\frac{\text{B.P.}}{\cdot}$ liq. ·885

ELEMENTS—*continued.*

A.V.	M.P. [°C.]	B.P. (°C)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
6·86	[c. 1800°–1900°]	..	..	..	..	Whitish-grey metal, H, B.
14·7	[−39·4°]	(357·25°, 760 mm.)	1 (1·96, Cu = 100)	5·3	·00018153 at 0°–100°	White metal.
11·1	Above Pt	..	..	..	..	White metal, M.
6·5	[1400°-1420°] [1450°]	..	7·374	..	..	White (with grey-yell. tinge) metal, H, D, M.
13·3	..	..	..	..	..	Steel-grey metal.
16·6 at B.P.	[−214°]	(−194·4°)	..	·98 (air = 1) (·993)	·003677	Colourless gas.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
OSMIUM **Os**	47·57	**190·3**	..	·03113 at 19° to 98°	5·9	$\frac{17\cdot5}{\cdot}$ 22·477
OXYGEN **O**	7·98	**15·96**	31·92	S.H.p. ·21751 at 13° to 217°	..	..
PALLADIUM **Pd**	26·57	**106·3**	..	·0582 at 0°	6·2	$\frac{22\cdot5}{\cdot}$ 11·4
PHOSPHORUS **P** Ord. crys.	10·32	**30·96**	123·84 and 61·92	·1699 at −78° to 10°	5·26	$\frac{0}{\cdot}$ 1·8367
				·1884 at 7° to 13°	..	$\frac{20}{\cdot}$ 1·8232
				·202 at 13° to 36°	..	$\frac{40}{\cdot}$ 1·8068
				·2045 liquid	6·34	$\frac{\text{B.P.}}{\cdot}$ 1·485
Red				·1698 at 15° to 98°	..	$\frac{17}{\cdot}$ 2·106 2·19
Crys. met.				..	..	$\frac{155}{\cdot}$ 2·34

ELEMENTS—*continued.*

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
8·5	Infus. in H–O flame.	..	..	..	·00000657	Bluish-white metal.
13·7 at B.P.	..	(−181·4, 740 mm.)	..	..	·0036743 at 21°–98°, 760 mm.	Bluish liquid; colourless gas.
9·3	[1585°]	..	12·64 at 17·2 (Ag at 0° = 100)	..	·00001176 at 40°	White metal, H, D, M.
c. 17	[44·2°]	(287·3° at 762 mm.)	..	..	..	Colourless, semi-transparent, non-metal, dodecah. and octah.
c. 21 at B.P.	[44·3°]					
c. 14·7	...	..	..	..	..	Dark-red powder. Amorph.
c. 13·2	..	..	..	..	..	Black rhomboh. crys. (? contg. Pb).

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
PLATINUM **Pt**	48·575	**194·3**	..	·03243 ·0314	6·3	$\frac{17·6}{\cdot}$ 21·5
POTASSIUM **K**	39·04	**39·04**	(39·04)	·166 at −78° to 10°	6·5	$\frac{15}{\cdot}$ ·865 $\frac{13}{\cdot}$ ·875
RHODIUM **Rh**	25·67	**102·7**	..	·058 at 10° to 97° (containing Ir)	6·0	12·1
RUBIDIUM **Rb**	85·2	**85·2**	..	(Probably c. ·075)	..	(1·52)
RUTHENIUM **Ru**	25·3	**101·4**	..	·0611 at 0° to 100°	6·4	$\frac{0}{4}$ 12·63
SCANDIUM **Sc**	14·66	**44**	..	..	..	(c. 2·55)
SELENION **Se**	39·4	**78·8**	157·6	·0732 at −20° to 7° (crys.) ·0746 at −27° to 8° (amorph.)	.. 5·9	4·7 (crys.) 4·3 (amorph.)

ELEMENTS—*continued.*

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
9	[c. 1775°]	..	8·042 at 12·5° (Ag = 100°)	37·9	·00000899 at 40°	Greyish-white metal, M, D, cubical.
45·1	[62·5°]	(667°)	11·23 at 0° 5·586 at 100°	45	·00008415 at 0°–50°	Silver-white metal, S, octah.
8·5	[c. 2000°]	..	..	..	·0000085 at 40°	Blue greyish-white metal, H, D, M.
56	[c. 38·5°]	..	..	..	..	Lustrous white metal.
8·03	[Above 2000°]	..	..	..	·00000963 at 40°	White metal, H, B.
(c. 17·2)	..	..	..	..	..	Not yet isolated.
16·7	[217°; crys.]	(676°–683°)	..	..	·0000368 at 40° (vitreous)	Non-metal. Exists in about five forms.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
SILICON **Si**	7·07	**28·3**	..	·136 at 40° ·183 at 57° ·203 at 232°	5·7	$\frac{10}{\cdot}$ 2·49 2·194–2·197
SILVER **Ag**	107·66	**107·66**	..	·0557 at 0° to 100° ·0559 ·05722	6·1	10·57 9·46–9·5 (liq.)
SODIUM **Na**	22·995	**22·995**	22·995 ?	·2734 at −28° to 6° ·21 (liquid)	6·3	$\frac{0}{4}$ ·985 $\frac{10}{\cdot}$ ·9743 $\frac{\text{B.P.}}{\cdot}$ c. 74
STRONTIUM **Sr**	43·65	**87·3**	..	..	..	2·4–2·58
SULPHUR **S** Rhombic	15·99	**31·98**	63·96 191·88 ? 255·84 ?	·163 at 17° to 45° ·1776 at 0° to 100° ·178	5·2 5·7	2·03 1·801-1·815 (molten)
Monocl.						1·982
Insol.						1·958 2·04

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
(c. 12·5)	[1100°–1300°]	..	..	..	·00000763 at 40°	*Crys.* metal-like, opaque, dark grey, lustrous. Octah. *Amorph.* Lustrous brown powder.
10·18	[960·5°]	..	57·226 (soft)	100	·00002 at 0°–100°	White metal, M, D.
..	..	..	63·845 (hard)		·00003721 at 0° to M.P.	
23·3	[95·6°]	(860°–950°)	18·3 at 0°	36·5	·00007105 at 0°–50°	Silver-white (pale rose). Octahed.
		(742°)	8·3 at 120°			
(34·5)						
15·9	[111°–115°]	(440°) (444·53° at 760 mm.)	..	..	·00006413 at 40°	Exists in about six allotropic forms. All change gradually to rhombic (octahedral).
16·4	[114·5°]	(448°)				

U. OF ILL. LIB.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
TANTALUM **Ta**	c. 60·67	c. 182	..	..	..	..
TELLURIUM **Te**	c. 62·5	c. 125	..	·0475 at 21° to 51° (crys.) ·0483 at 98° (crys.) ·0518 at 98°	5·9	$\frac{18\cdot2}{\cdot}$ 6·255
THALLIUM **Tl**	203·64	203·64	407·28 at c. 1700	·0325 ·0335 at 17° to 100°	.. 6·8	11·81–11·91
THORIUM **Th**	58	232	..	·02787 at 0° to 100°	6·4	$\frac{17}{\cdot}$ 11·1
TIN **Sn**	59·4	118·8	..	·0559 at 0° to 100° ·0548 ·0637 at 250° to 350°	6·6	7·3
TITANIUM **Ti**	11·97	47·9	..	·1135 at 0° to 100° ·1288 at 0° to 211° ·1485 at 0° to 301° ·162 at 0° to 440°	5·4 7·7	$\frac{0}{4}$ 3·5888
TUNGSTEN **W**	30·6	183·6	..	·035 at 6° to 15° ·0334	6·4	$\frac{4}{\cdot}$ 19·13 18·77

ELEMENTS—*continued.*

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
..	..	..	..	..	..	Unknown in pure form.
c. 20	[c. 455°]	(c. 1390°)	·000777 at 0° Ag at 0° = 1	..	·00001675 at 0°	White shining semi-metal, B. Hexag. rhombohed.
17·1	[282°]	(Full red)	5·225 at 0°	..	·00003021 at 40°	White metal, S.M. Octahed.
20·9	..	..	..	..	..	Greyish-white metal, Octah. and hexag.
16·3	[231·6°]	(1450°–1600°)	8·726 at 0° 8·823 at 15° 6·091 at 100°	15·2	·00002296 at 0°–100°	Silver-white metal, M. Rhomb. and quad. (?)
13·4	Never fused	..	..	..	..	Dark grey powder. Amorph.
9·6	[Melts in O–H flame]	..	..	..	..	Steel-grey crys. powder, H, B.

Element. Name and Symbol.	Eq.	A.W.	M.W.	S.H. at Temp. °C.	A.H. S.H.×A.W.	S.G.
URANIUM **U**	c. 59·7	c. 239	..	·0276 at 100°	6·6	$\frac{13}{4}$ 18·685
VANADIUM **V**	17·07	51·2	..	..	..	$\frac{15}{\cdot}$ 5·5
YTTRIUM **Y**	29·87	89·6	..	..	..	(c. 3·7)
ZINC **Zn**	32·65	65·3	65·3 at 1400°	·0935 at 0° to 100° ·0932 at 19° to 47° ·0955	6·1	6·9–7·[illegible]
ZIRCONIUM **Zr**	c. 45	c. 90	..	·066 at 0° to 100°	6·0	4·15–4·25

RARE AND DOUBTFUL ELEMENTS.—In addition to the elements given in this table, a number of others have been
and Krypton (A.W. c. 80) (Rayleigh and Ramsay) are gases exhibiting no power of entering into combination; they
Thus Didymium appears to have been split (by Nilson and Krüss) into nine elements, 'Neodymium' and 'Praseody-
ultimate element, and "old erbia" has been split into scandia, ytterbia, terbia, "new erbia," holmia, thulia and
complex oxide, and to consist of five or six bodies. Decipium, Columbium, Rogerium, Mosandium, two earth metals
elements, that is, compounds or intimate mixtures of simpler bodies. Crookes is of opinion that perhaps nearly sixty
the undoubtedly sound work done upon it; but there would appear to be a milky way of elements in the rare earths, and
but constellations. Some other elements of the Argon family, viz. Krypton, probably c. 80, and Metargon, c. 40, have lately

A.V.	M.P. [°C.]	B.P. (°C.)	E.C. at °C. Hg at 0° = 1.	T.C. Ag=100.	C.E. lin. at °C.	Physical State.
12·8	[Nearly white heat]	..	..	..	..	Silver-white metal, H, M.
9·3	Above Mo	..	..	..	..	Light grey lustrous crys. powder.
(c. 21)	..	..	..	..	..	Unknown in pure form.
9·4	[419°] [417·57°]	(930°–954°)	16·1 at 0° 16·92 at 100°	28·1	·00002976 at 0°–100°	Bluish-white metal, S, M (at 100°–150°). Hexag.
(21·2)	[Above 1300°]	..	..	..	..	Lustrous greyish crys., solid, H,B. Also as black amorph. powder.

described which are very rare, and in many cases doubtful. Helium (A.W. c. 4), Neon (A.W. c. 20), Argon (A.W. c. 40)
probably have monatomic molecules. Of the elements given in the table, several are certainly not ultimate elements.
mium' each being simply a group of these. In like manner Crookes and others have shown that Erbium is not an
phillippia (but this is a mixture of yttria and terbia). Yttria has been shown by Crookes and others to be a very
termed Gadolinium, &c., have been described, of which some are more than doubtful and others probably meta-
elements or quasi-elements are contained in the rare earths. This branch of chemistry is still obscure, notwithstanding
the higher atom analogues (*V.* pp. 58–62) of aluminium, silicon, &c., e.g. yttria and erbia seem to be not single elements
been described by Ramsay and Travers. Coronium, Polonium, Radium, are new stars whose light is as yet rather faint.

THE ATOMIC WEIGHTS OF THE ELEMENTS. (F. W. Clarke.)

(From the Sixth Annual Report of Committee on Atomic Weights, Journ. Am. Chem. Soc., xxi. No. 2.)

Element.	H = 1.	O = 16.
Aluminium	26·91	27·11
Antimony	119·52	120·43
Argon	?	?
Arsenic	74·44	75·01
Barium	136·39	137·43
Bismuth	206·54	208·11
Boron	10·86	10·95
Bromine	79·34	79·95
Cadmium	111·54	112·38
Cæsium	131·89	132·89
Calcium	39·76	40·07
Carbon	11·91	12·00
Cerium	138·30	139·35
Chlorine	35·18	35·45
Chromium	51·74	52·14
Cobalt	58·55	58·99
*Columbium	93·02	93·73
Copper	63·12	63·60
Erbium	165·06	166·32
Fluorine	18·91	19·06
Gadolinium	155·57	156·76
Gallium	69·38	69·91
Germanium	71·93	72·48
†Glucinum	9·01	9·08
Gold	195·74	197·23
Helium	?	?
Hydrogen	1·000	1·008
Indium	112·99	113·85
Iodine	125·89	126·85
Iridium	191·66	193·12
Iron	55·60	56·02
Lanthanum	137·59	138·64
Lead	205·36	206·92
Lithium	6·97	7·03
Magnesium	24·10	24·28

* Syn. Niobium. † Syn. Beryllium.

THE ATOMIC WEIGHTS OF THE ELEMENTS—*continued.*

Element.	H = 1.	O = 16.
Manganese	54·57	54·99
Mercury	198·49	200·00
Molybdenum	95·26	95·99
Neodymium	142·52	143·60
Nickel	58·24	58·69
Nitrogen	13·93	14·04
Osmium	189·55	190·99
Oxygen	15·88	16·00
Palladium	105·56	106·36
Phosphorus	30·79	31·02
Platinum	193·41	194·89
Potassium	38·82	39·11
Praseodymium	139·41	140·46
Rhodium	102·23	103·01
Rubidium	84·78	85·43
Ruthenium	100·91	101·68
Samarium	149·13	150·26
Scandium	43·78	44·12
Selenium	78·58	79·17
Silicon	28·18	28·40
Silver	107·11	107·92
Sodium	22·88	23·05
Strontium	86·95	87·61
Sulphur	31·83	32·07
Tantalum	181·45	182·84
Tellurium	126·52	127·49
Terbium	158·80	160·00
Thallium	202·61	204·15
Thorium	230·87	232·63
Thulium	169·40	170·70
Tin	118·15	119·05
Titanium	47·79	48·15
Tungsten	183·43	184·83
Uranium	237·77	239·59
Vanadium	50·99	51·38
Ytterbium	171·88	173·19
Yttrium	88·35	89·02
Zinc	64·91	65·41
Zirconium	89·72	90·40

The Elements arranged by Mendelejeff acccording to Newlands's (Periodic) Classification.

Even.									
I.	II.	III.	IV.	V.	VI.	VII.	VIII.		
Li 7·01	Be 9·0	B 11·0	C 11·97	N 14·01	O 15·96	Fl 19·1			
K 39·04	Ca 39·9	—	Ti 48·0	V 51·2	Cr 52·4	Mn 54·8	Fe 55·9	Co 58·6	Ni 58·6
Rb 85·2	Sr 87·2	Yt 93·0	Zr 90·0	Nb 94·0	Mo 95·6	—	Ru 85·2	Rh 104·1	Pd 106·2
Cs 133·0	Ba 136·8	La 139·0	Ce 141·2	—	—	—	—	—	—
—	—	Er 169·0	Di 147·0	Ta 182·0	W 184·0	—	Os 198·6	Ir 196·7	Pt 196·7
—	—	—	Th 234·5	—	U 240·0	—	—	—	—
R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7	RO_4		

THE ELEMENTS ARRANGED BY MENDELEJEFF ACCORDING TO NEWLANDS'S (PERIODIC) CLASSIFICATION—*continued.*

VIII.			Odd.						
			I.	II.	III.	IV.	V.	VI.	VII.
			H 1						
			Na 22·96	Mg 23·94	Al 27·3	Si 28·0	P 30·96	S 31·98	Cl 35·37
Fe 55·9	Co 58·6	Ni 58·6	Cu 63·0	Zn 64·9	Ga 68	—	As 74·9	Se 78·0	Br 79·75
Ru 85·2	Rh 104·1	Pd 106·2	Ag 107·66	Cd 111·6	In 113·4	Sn 117·8	Sb 122·0	Te 128·0	I 126·53
—	—	—	—	—	—	—	—	—	—
Os 198·6	Ir 196·7	Pt 196·7	Au 196·2	Hg 199·8	Tl 203·6	Pb 206·4	Bi 210·0	—	—
—	—	—	—	—	—	—	—	—	—
RO_4			R_2O	RO	R_2O_3	RO_2	R_2O_5	RO_3	R_2O_7

PERIODIC LAW. ARRANGEMENT IN DOUBLE PERIODS. (Mendelejeff.)

	H							Typical Periods.
(1)	Li	Be	B	C	N	O	F	
(2)	Na	Mg	Al	Si	P	S	Cl	

(3)	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Ni	Co	Cu	Zn	Ga	Ge	As	Se	Br
(4)	Rb	Sr	Yt	Zr	Nb	Mo	—	Rh	Ru	Pd	Ag	Cd	In	Sn	Sb	Te	I
(5)	Cs	Ba	La	Ce	*pr*-Di	*ne*-Di	—	—	—	—	—	—	—	—	—	—	—
(6)	—	—	—	—	Ta	W	—	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	—	—
(7)	—	—	—	Th	—	U	—	—	—	—	—	—	—	—	—	—	—
	Even series.							Eighth group.			Odd series.						

PERIODIC LAW. ARRANGEMENT OF THE ELEMENTS IN CYCLES. (Bayley.)

I.	II.	III.	IV.	V.	VI.	VII.
					Cs 132·7	(Ie) (c. 223·7)
					Ba 136·8	— (c. 228·2)
					La 138·2	— (c. 230·8)
					Ce 139·9	Th. 232
					n-Di 140·8	(c. 233·2)
					pr-Di 143·6	U 239
					Sm ? (147·5)	—
					—	—
					— (c. 151·7)	—
					— (c. 154·5)	—
					— (c. 159·4)	—
					— (c. 161·3)	—
					— (c. 166)	—
					— (c. 167)	—
					— (c. 168·8)	—
					—	—
			K 39·04	Rb 85·2	— (c. 169·4)	—
			Ca 39·91	Sr 87·3	— (c. 171·3)	—
			Sc 44	Yt 89·6	— (c. 173·7)	—
			Ti 47·9	Zr c. 90	— (c. 175·6)	—
			V 51·2	Nb 94	Ta (c. 182)	—
H 1	Li 7·01	Na 22·9	Cr 52·45	Mo 95·9	W 183·6	—
—	Be 9·08	Mg 24	Mn 55	— c. 100	(c. 186·7)	—
—	B 10·97	Al 27·02	—	—	—	—
—	C 11·97	Si 28·3	Fe 55·9	Ru 101·4	Os 190·3	—
—	N 14·01	P 30·96	Ni 58·6	Rh 102·7	Ir 192·5	—
—	O 15·96	S 31·98	Co 58·8	Pd 106·3	Pt 194·3	—
—	F 19	Cl 35·37	—	—	—	—
He 4·2	Ne (22)	Ar (39·9)	Cu 63·2	Ag 107·66	Au 196·7	—
		mAr (37?)	Zn 65·3	Cd 111·7	Hg 199·8	—
			Ga 69·9	In 113·4	Tl 203·64	—
			Ge 72·32	Sn 118·8	Pb 206·4	—
			As 74·9	Sb 120	Bi 208	—
			Se 78·8	Te c. 125	— (c. 212)	—
			Br 79·75	I 126·53	— (c. 214·8)	—
			Kr (82·2)	— (c. 127·33)	— (c. 215·6)	—

The author's (Phil. Mag., Jan. 1882; Proc. R I.A., 1883; Chem. News, April 1898) arrangement in cycles (*vide* p. 61) differs from the various arrangements in the Periodic system in some important respects.

The position of an element in the cycle determines its properties. The first element is always an alkali metal, the second element is an alkaline earth metal, and the third an earth metal forming basic oxides of the form M_2O_3, not reducible by hydrogen at a red heat. In the case of boron, the third element in the second cycle, the formula of the oxide is regular, but its basic properties are overpowered by acidic qualities, owing probably to the lowness of the atomic weight of boron. In the higher cycles all the elements occupying a *region* following the respective alkaline earth metal are earth metals, although the formula of the oxides is determined by the sequence of the elements in the primary septenary (or octogenary) series. Family relations are perfect only between elements occupying the same cyclic position; thus Li, Na, K, Rb, Cs (and the unknown alkali metal of at. wt. c. 223·7) are true alkali metals: they are members of the same family and have the same cyclic position, while in the sub-family composed of (Li, Na), Cu, Ag, and Au, the resemblances between the two first members (Li, Na) and the succeeding heavy metals (Cu, Ag, Au) are, for the most part, only structural resemblances between the oxides, chlorides, &c., of lithium and sodium and the oxides, chlorides, &c., of the heavy metals of the sub-family. These heavy metals, although, like Li and Na, each is the first element in a primary septenary (or octogenary) series, have a cyclic position quite unlike that of their lower atom analogues. It will be observed that there is no vacancy in the cyclic system for the unknown element of at. wt. c. 170, indicated as a member of the alkali-metal family in the periodic system. The element of at. wt. c. 170 in this table is shown as an earth metal of Group I.

In the case of N and its atom analogues

$$\mathrm{N - P} \left\langle \begin{array}{l} \mathrm{V - Nb - \&c.} \\ \mathrm{As - Sb - \&c.} \end{array} \right.$$

the group N, P, As, Sb occupy positions on the lower portion of the respective cycles, while the elements V, Nb, &c., occupy positions in the higher portion of the cycles.

Again, F, Cl, Br, I, and the unknown element of at. wt. c. 214·8, form a true family occupying similar cyclic positions, while in the group F, Cl, Mn, &c., the family relations are very indistinct, and some of their properties are reversed.

Thomsen has recently published an arrangement almost identical with the cyclic system.

MULTIPLES AND LOGARITHMS OF THE ATOMIC WEIGHTS AND SOME GROUPS OF ELEMENTS.

—	1	2	3	4	5	6	7	8	9	Log.
	·0000000	·3010300	·4771213	·6020600	·6989700	·7781513	·8450980	·9030900	·9542425	
Al	27·02	54·04	81·06	108·08	135·10	162·12	189·14	216·16	243·18	1·4316853
Sb	120·	240·	360·	480·	600·	720·	840·	960·	1080·	2·0791812
As	74·9	149·8	224·7	299·6	374·5	449·4	524·3	599·2	674·1	1·8744818
Ba	136·8	273·6	410·4	547·2	684·0	820·8	957·6	1094·4	1231·2	2·1360861
Bi	208·	416·	624·	832·	1040·	1248·	1456·	1664·	1872·	2·3180663
B	10·97	21·94	32·91	43·88	54·85	65·82	76·79	87·76	98·73	1·0402066
Br	79·75	159·50	239·25	319·00	398·75	478·50	558·25	638·00	717·75	1·9017307
Cd	111·7	223·4	335·1	446·8	558·5	670·2	781·9	893·6	1005·3	2·0480532
Ca	39·91	79·82	119·73	159·64	199·55	239·46	279·37	319·28	359·19	1·6010817
C	11·97	23·94	35·91	47·88	59·85	71·82	83·79	95·76	107·73	1·0780942
Cl	35·37	70·74	106·11	141·48	176·85	212·22	247·59	282·96	318·33	1·5486351
Cr	52·45	104·90	157·35	209·80	262·25	314·70	367·15	419·60	472·05	1·7197455
Co	58·8	117·6	176·4	235·2	294·0	352·8	411·6	470·4	529·2	1·7693773
Cu	63·2	126·4	189·6	252·8	316·0	379·2	442·4	505·6	568·8	1·8007171
F	19·	38·	57·	76·	95·	114·	133·	152·	171·	1·2787536
Au	196·7	393·4	590·1	786·8	983·5	1180·2	1376·9	1573·6	1770·3	2·2938044
H	1	2	3	4	5	6	7	8	9	0·0000000
I	126·53	253·06	379·59	506·12	632·65	759·18	885·71	1012·24	1138·77	2·1021935
Fe	55·9	111·8	167·7	223·6	279·5	335·4	391·3	447·2	503·1	1·7474118
Pb	206·4	412·8	619·2	825·6	1032·0	1238·4	1444·8	1651·2	1857·6	2·3147097
Li	7·01	14·02	21·03	28·04	35·05	42·06	49·07	56·08	63·09	0·8457180
Mg	24·	48·	72·	96·	120·	144·	168·	192·	216·	1·3802112

MULTIPLES AND LOGARITHMS OF THE ATOMIC WEIGHTS, ETC.—*continued.*

—	1	2	3	4	5	6	7	8	9	Log.
	·0000000	·3010300	·4771213	·6020600	·6989700	·7781513	·8450980	·9030900	·9542425	
Mn	55·	110·	165·	220·	275·	330·	385·	440·	495·	1·7403627
Hg	199·8	399·6	599·4	799·2	999·0	1198·8	1398·6	1598·4	1798·2	2·3005955
Mo	95·9	191·8	287·7	383·6	479·5	575·4	671·3	767·2	863·1	1·9818186
Ni	58·6	117·2	175·8	234·4	293·0	351·6	410·2	468·8	527·4	1·7678976
N	14·01	28·02	42·03	56·04	70·05	84·06	98·07	112·08	126·09	1·1464381
O	15·96	31·92	47·88	63·84	79·80	95·76	111·72	127·68	143·64	1·2030329
P	30·96	61·92	92·88	123·84	154·8	185·76	216·72	247·68	278·64	1·4908010
Pt	194·3	388·6	582·9	777·2	971·5	1165·8	1360·1	1554·4	1748·7	2·2884728
K	39·04	78·08	117·12	156·16	195·20	234·24	273·28	312·32	351·36	1·5915098
Se	78·8	157·6	236·4	315·2	394·0	472·8	551·6	630·4	709·2	1·8965262
Si	28·3	56·6	84·9	113·2	141·5	169·8	198·1	226·4	254·7	1·4517864
Ag	107·66	215·32	322·98	430·64	538·30	645·96	753·62	861·28	968·94	2·0320544
Na	22·995	45·990	68·985	91·980	114·975	137·970	160·965	193·960	216·955	1·3616334
Sr	87·3	174·6	261·9	349·2	436·5	523·8	611·1	698·4	785·7	1·9410142
S	31·98	63·96	95·94	127·92	159·90	191·88	223·86	255·84	287·82	1·5048785
Sn	118·8	237·6	356·4	475·2	594·0	712·8	831·6	950·4	1069·2	2·0748164
Ti	47·9	95·8	143·7	191·6	239·5	287·4	335·3	383·2	431·1	1·6803355
W	183·6	367·2	550·8	734·4	918·0	1101·6	1285·2	1468·8	1652·4	2·2638727
U	239·	478·	717·	956·	1195·	1434·	1673·	1912·	2151·	2·3783979
V	51·2	102·4	153·6	204·8	256·0	307·2	358·4	409·6	4 0·8	1·7092700
Zn	65·3	130·6	195·9	261·2	326·5	391·8	457·1	522·4	587·7	1·8149132
Zr	90·	180·	270·	360·	450·	540·	630·	720·	810·	1·9542425

MULTIPLES AND LOGARITHMS OF THE ATOMIC WEIGHTS, ETC.—*continued*

—	1	2	3	4	5	6	7	8	9	Log.
	·0000000	·3010300	·4771213	·6020600	·6989700	·7781513	·8450980	·9030900	·9542425	
– aq	17·96	35·92	53·88	71·84	89·80	107·76	125·72	143·68	161·64	1·2543063
NH_4	18·01	36·02	54·03	72·04	90·05	108·06	126·07	144·08	162·09	1·2555137
NH_2	16·01	32·02	48·03	64·04	80·05	96·06	112·07	128·08	144·09	1·2043913
NH	15·01	30·02	45·03	60·04	75·05	90·06	105·07	120·08	135·09	1·1763807
CNS	57·96	15·92	173·88	231·84	289·80	347·76	305·72	363·68	421·64	1·7631284
NO_2	45·93	191·86	137·79	183·72	229·65	275·58	321·51	367·44	413·37	1·6620964
CH_2	13·97	27·94	41·91	55·88	69·85	83·82	97·79	111·76	125·73	1·1451964
CH_3	14·97	29·94	44·91	59·88	74·85	89·82	104·79	119·76	134·73	1·1752218
C_2H_5	28·94	57·88	86·82	115·76	144·70	173·64	202·58	231·52	260·46	1·4614985
C_3H_7	42·91	85·82	128·73	171·64	214·55	257·46	300·37	343·28	386·19	1·6325585
C_4H_9	56·88	13·76	170·64	227·52	284·40	341·28	398·16	455·04	511·92	1·7549596
C_5H_{11}	70·85	141·70	212·55	283·40	354·25	425·10	495·95	566·80	637 65	1·8503399
C_6H_5	76·82	153·64	230·46	307·28	384·10	460·92	537·74	614·56	691·38	1·8854743
HO	16·96	133·92	50·88	67·84	84·80	101·76	118·72	135·68	152·64	1·2294258
CH_2HO	30 93	61 86	92·79	123·72	154·65	185·58	216·51	247·44	278 37	1·4903799
CHHO	29·93	59·86	89·79	119·72	149·65	179·58	209·51	239·44	269·37	1·4761067
COH	28·93	57·86	86·79	115·72	144·65	173·58	202·51	231·44	260·37	1·4613484
COHO	44·89	89·78	134·67	179·56	224·45	269·34	314·23	359·12	404·01	1·6521496
CH	12·97	25·94	38·91	51·88	64·85	77·82	90·79	103·76	116·73	1·1129400
CN	25·98	51·96	77·94	103·92	129·90	155·88	181·86	207·84	233·82	1·4146391
CO	27·93	55·86	83·79	111·72	139·65	167·58	195·51	223·44	251·37	1·4460709
SO_3	79·86	159·72	239·58	319·44	399·30	479·16	559·02	638·88	718·74	1·9023293

FACTORS AND THEIR LOGARITHMS, GIVING THE AMOUNT OF THE CONSTITUENT SOUGHT BY SIMPLE MULTIPLICATION.

This table is calculated from the atomic weights given in the tables on pp. 34–55, which are those adopted in Watts' 'Dictionary of Chemistry' (Morley and Muir). The logarithm of a factor not contained in the table may often be readily found by adding two logarithms.

Thus, if the factor for converting ZnO to $ZnCl_2$ be required, then

Factor for ZnO to Zn = $\bar{1}$·9050364 from the table
,, Zn to $ZnCl_2$ = 0·3187534 ,,
,, ZnO to $ZnCl_2$ = 0·2237898 (required)

The table itself has been checked for nearly every factor by such transformations, and for this purpose some factors which were necessary as links were calculated but not printed. This method, although it does not exclude all possibility of error, tends greatly to ensure accuracy.

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
Aluminium.					
Al_2O_3	Al_2	·5302	$\bar{1}$·7244559	1·8860	0·2755441
Potash-alum	Ammonia-alum	·9556	$\bar{1}$·9802578	1·0465	0·0197422
Potash-alum	Al_2	·0571	$\bar{2}$·7566222	17·514	1·2433778
Ammonia-alum ..	Al_2	·0597	$\bar{2}$·7763644	16·735	1·2236356
$Al_2P_2O_8$	Al_2	·2218	$\bar{1}$·3459667	4·5085	0·6540333
$Al_2P_2O_8$	Al_2O_3	·4183	$\bar{1}$·6215108	2·3905	0·3784892
Ammonium and N.					
NH_4Cl	N	·2625	$\bar{1}$·4190595	3·8101	0·5809405
NH_4Cl	NH_3	·3186	$\bar{1}$·5033257	3·1381	0·4966743

A.	B.	To convert.			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
AMMONIUM and N—*cont.*					
NH_4Cl	NH_4	·3374	$\bar{1}$·5281351	2·9639	0·4718649
NH_4Cl	NH_4OH	·6551	$\bar{1}$·8163170	1·5265	0·1836830
$2NH_4Cl$	$(NH_4)_2O$	·4869	$\bar{1}$·6874277	2·0539	0·3125723
N	NH_3	1·2142	0·0842662	·8236	$\bar{1}$·9157338
N	NH_4	1·2855	0·1090756	·7779	$\bar{1}$·8909244
N_2	$(NH_4)_2SO_4$	4·7052	0·6725791	·2125	$\bar{1}$·3274209
$2NH_3$	$(NH_4)_2SO_4$	3·8754	0·5883129	·2580	$\bar{1}$·4116871
$2NH_4Cl$	$(NH_4)_2SO_4$	1·2349	0·0916386	·8097	$\bar{1}$·9083614
$2NH_4Cl,PtCl_4$	N_2	·0633	$\bar{2}$·8015156	15·794	1·1984844
$2NH_4Cl,PtCl_4$	$2NH_3$	·0769	$\bar{2}$·8857818	13·008	1·1142182
$2NH_4Cl,PtCl_4$	$2NH_4$	·0814	$\bar{2}$·9105912	12·286	1·0894088
$2NH_4Cl,PtCl_4$	$2NH_4Cl$	·2412	$\bar{1}$·3824561	4·1452	0·6175439
$2NH_4Cl,PtCl_4$	$2NH_4OH$	·1580	$\bar{1}$·1987731	6·3274	0·8012269
$2NH_4Cl,PtCl_4$	$(NH_4)_2O$	·1175	$\bar{1}$·0698838	8·5137	0·9301162
N	HNO_3	4·4889	0·6521435	·2228	$\bar{1}$·3478565
N	$NaNO_3$	6·0589	0·7823929	·1650	$\bar{1}$·2176071
N	KNO_3	7·2041	0·8575822	·1388	$\bar{1}$·1424178
$NaNO_3$	KNO_3	1·1890	0·0751893	·8410	$\bar{1}$·9248107
N_2	N_2O_5	3·848	0·5852312	·2599	$\bar{1}$·4147688
N_2O_5	$2KNO_3$	1·8722	0·2723510	·5341	$\bar{1}$·7276490
N_2O_5	$2NaNO_3$	1·5746	0·1971616	·6351	$\bar{1}$·8028384

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
AMMONIUM and N—*cont.*					
N_2O_5	$Ca(NO_3)_2$	1·5182	0·1813228	·6587	$\bar{1}$·8186772
N_2O_5	$Mg(NO_3)_2$	1·3706	0·1369164	·7296	$\bar{1}$·8630836
$(NH_4)_2SO_4$	H_2SO_4	·7420	$\bar{1}$·8703805	1·3478	0·1296195
$Mg(NO_3)_2$	$Ca(NO_3)_2$	1·1077	0·0444064	·9028	$\bar{1}$·9555936
Antimony.					
Sb_2O_4	Sb_2	·7899	$\bar{1}$·8975663	1·266	0·1024337
Sb_2S_3	Sb_2	·7144	$\bar{1}$·8539495	1·3998	0·1460505
Sb_2O_3	Sb_2	·8337	$\bar{1}$·9209997	1·1995	0·0790003
Sb_2O_3	$2SbO_3$	1·1636	0·0658175	·8594	$\bar{1}$·9341825
Sb_2O_3	Sb_2S_3	1·1670	0·0670502	·8569	$\bar{1}$·9329498
Sb_2O_3	Sb_2O_5	1·1109	0·0456670	·9002	$\bar{1}$·9543330
Sb_2O_3	$2SbS_4$	1·7224	0·2361301	·5806	$\bar{1}$·7638699
Sb_2O_3	Sb_2S_5	1·3891	0·1427399	·7199	$\bar{1}$·8572601
Sb_2O_3	Sb_2O_4	1·0554	0·0234334	·9475	$\bar{1}$·9765666
Sb_2O_5	Sb_2	·7505	$\bar{1}$·8753327	1·3325	0·1246673
Sb_2O_5	$2SbO_4$	1·1495	0·0605915	·8698	$\bar{1}$·9394085
Sb_2O_5	$2SbO_3$	1·0475	0·0201505	·9547	$\bar{1}$·9798495
Sb_2O_5	$2SbS_4$	1·5055	0·1904631	·6450	$\bar{1}$·8095369
Sb_2O_5	Sb_2O_4	·9501	$\bar{1}$·9777664	1·0525	0·0222336
Sb_2O_5	Sb_2S_5	1·2505	0·0970729	·7997	$\bar{1}$·9029271

FACTORS AND THEIR LOGARITHMS, ETC.—*continued*

A.	B.	To convert A into B. Factor.	A into B. Log.	B into A. Factor.	B into A. Log.
ANTIMONY—*continued.*					
Sb_2O_5	Sb_2S_3	1·0505	0·0213832	·9520	$\bar{1}$·9786168
Sb_2S_3	Sb_2O_4	·9044	$\bar{1}$·9563832	1·1056	0·0436168
Sb_2S_5	Sb_2O_4	·7598	$\bar{1}$·8806935	1·3162	0·1193065
Sb_2S_5	Sb_2S_3	·8400	$\bar{1}$·9243103	1·1904	0·0756897
Arsenic.					
$Na_2H_2Sb_2O_7$	Sb_2	·6004	1·7784662	1·6655	0·2215338
$NH_4MgAsO_4\frac{1}{2}aq$ ..	As	·3948	$\bar{1}$·5963458	2·5331	0·4036542
$NH_4MgAsO_4\frac{1}{2}aq$ ..	As_2O_3	·5210	$\bar{1}$·7167967	1·9166	0·2832033
$NH_4MgAsO_4\frac{1}{2}aq$ ..	As_2O_5	·6051	1·7818059	1·6527	0·2181941
$Mg_2As_2O_7$	As_2	·4840	$\bar{1}$·6848231	2·0662	0·3151769
$NH_4MgAsO_4\frac{1}{2}aq$ ..	$Mg_2As_2O_7$	·8157	$\bar{1}$·9115227	1·2214	0·0884773
As_2O_3	As_2	·7578	$\bar{1}$·8795491	1·3196	0·1204509
As_2S_3	As_2	·6096	$\bar{1}$·7850359	1·6405	0·2149641
As_2S_3	As_2O_3	·8044	$\bar{1}$·9054868	1·2431	0·0945132
As_2S_3	As_2O_5	·9343	$\bar{1}$·9704960	1·0703	0·0295040
Barium (*v.* also S).					
$BaSO_4$	Ba	·5881	$\bar{1}$·7694390	1·7004	0·2305610
$BaSO_4$	BaO	·6567	$\bar{1}$·8173625	1·5228	0·1826375
$BaSO_4$	$BaCO_3$	·8454	$\bar{1}$·9270469	1·1829	0·0729531

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert A into B. Factor.	To convert A into B. Log.	To convert B into A. Factor.	To convert B into A. Log.
BARIUM—*continued.*					
$BaSO_4$	$BaCl_2$	·8922	$\bar{1}$·9504547	1·1208	0·0495453
$BaSO_4$	$BaCl_2$, 2aq	1·0466	0·0197805	·9554	$\bar{1}$·9802195
$BaSO_4$	$CaSO_4$	·5835	$\bar{1}$·7660287	1·0554	0·2339713
$BaSO_4$	$CaSO_4$, 2aq	·7379	$\bar{1}$·8679967	1·3552	0·1320033
$BaSO_4$	K_2SO_4	·7476	$\bar{1}$·8736525	1·3377	0·1263475
$BaSO_4$	Na_2SO_4	·6096	$\bar{1}$·7850598	1·6404	0·2149402
$BaSO_4$	$(NH_4)_2SO_4$	·5668	$\bar{1}$·7534001	1·7644	0·2465999
$BaSO_4$	2KHO	·4815	$\bar{1}$·6825709	2·0770	0·3174291
BaO	Ba	·8955	$\bar{1}$·9520765	1·1167	0·0479235
$BaCO_3$	Ba	·6956	$\bar{1}$·8423921	1·4375	0·1576079
$BaCO_3$	BaO	·7768	$\bar{1}$·8903156	1·2873	0·1096844
$BaCO_3$	$BaCl_2$	1·0554	0·0234078	·9475	$\bar{1}$·9765922
$BaCl_2$	$BaCl_2$, 2aq	1·1731	0·0693258	·8525	$\bar{1}$·9306742
$BaCrO_4$	Ba	·5405	$\bar{1}$·7328111	1·8501	0·2671889
$BaCrO_4$	BaO	·6036	$\bar{1}$·7807346	1·6568	0·2192654
$BaCrO_4$	$BaCl_2$	·8200	$\bar{1}$·9138268	1·2195	0·0861732
$BaCrO_4$	$BaSO_4$	·9191	$\bar{1}$·9633721	1·0880	0·0366279
$BaCl_2$	Ba	·6591	$\bar{1}$·8189843	1·5171	0·1810157
$BaCl_2$	BaO	·7360	$\bar{1}$·8669078	1·3586	0·1330922
$BaSiF_6$	Ba	·4901	$\bar{1}$·6903263	2·0402	0·3096737
$BaSiF_6$	BaO	·5473	$\bar{1}$·7382498	1·8271	0·2617502

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
BARIUM—*continued.*					
$BaSiF_6$	BaF_2	·6263	$\bar{1}$·7967816	1·5967	0·2032184
$BaSiF_6$	$BaSO_4$	·8335	$\bar{1}$·9208873	1·1998	0·0791127
BaF_2	Ba	·7826	$\bar{1}$·8935447	1·2778	0·1064553
$Ba(NO_3)_2$	Ba	·5250	$\bar{1}$·7201450	1·9048	0·2798550
$Ba(NO_3)_2$	$BaSO_4$	·8927	$\bar{1}$·9507060	1·1202	0·0492940
Bismuth.					
Bi_2O_3	Bi_2S_3	1·1036	0·0428135	·9061	$\bar{1}$·9571865
Bi_2O_3	2Bi	·8968	$\bar{1}$·9526876	1·1151	0·0473124
Bi_2S_3	2Bi	·8126	$\bar{1}$·9098742	1·2306	0·0901258
BiOCl	Bi	·8027	$\bar{1}$·9042105	1·2468	0·0957895
2BiOCl	Bi_2O_3	·8944	$\bar{1}$·9515229	1·1181	0·0484771
$BiAsO_4$	Bi	·5999	$\bar{1}$·7780594	1·3242	0·1219406
$2BiAsO_4$..	Bi_2O_3	·6661	$\bar{1}$·8253718	1·4949	0·1746282
$2BiAsO_4$..	Bi_2S_3	·7382	$\bar{1}$·8681852	1·3546	0·1318148
Boron.					
B_2O_3	B_2	·3142	$\bar{1}$·4972568	3·1823	0·5027432
KBF_4	B	·0871	$\bar{2}$·9398016	11·487	1·0601984
$2KBF_4$	B_2O_3	·2770	$\bar{1}$·4425448	3·6096	0·5574552
$4KBF_4$	B_4O_7	·3087	$\bar{1}$·4895146	3·2393	0·5104554
B_2O_3	B_4O_7	1·1143	0·0469998	·8974	$\bar{1}$·9530002

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
Bromine.					
Br	I	1·5866	0·2004628	·6303	$\bar{1}$·7995372
AgBr	Br	·4255	$\bar{1}$·6289379	1·2350	0·3710621
AgBr	HBr	·4309	1·6343497	2·3209	0·3656503
AgBr	BrO_3	·6810	$\bar{1}$·8331600	1·4684	0·1668400
AgBr	Br_2O_5	·6384	$\bar{1}$·8051199	1·5663	0·1948801
Br	HBr	1·0125	0·0054118	·9876	$\bar{1}$·9945882
$2BrO_3$	B_2O_5	·9375	$\bar{1}$·9719599	1·0667	0·0280401
Cadmium.					
CdO	Cd	·8750	$\bar{1}$·9419984	1·1429	0·0580016
CdS	Cd	·7742	$\bar{1}$·8906569	1·2863	0·1093431
CdS	CdO	·8885	$\bar{1}$·9486585	1·1250	0·0513415
$Cd(NO_3)_2$	Cd	·4743	$\bar{1}$·6760992	2·1082	0·3239008
$Cd(NO_3)_2$	CdO	·5421	$\bar{1}$·7341008	1·8446	0·2658992
$CdSO_4$	Cd	·5385	$\bar{1}$·7312026	1·8570	0·2687974
$CdSO_4$	CdO	·6155	$\bar{1}$·7892042	1·6248	0·2107958
Calcium.					
CaO	Ca	·7143	$\bar{1}$·8539030	1·3999	0·1460970
CaO	$CaCO_3$	1·7856	0·2517777	·5600	$\bar{1}$·7482223
CaO	$CaSO_4$	2·4294	0·3854971	·4116	$\bar{1}$·6145029
CaO	$CaSO_4$, 2aq	3·0723	0·4874651	·3255	$\bar{1}$·5125349

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
CALCIUM—*continued.*					
CaO	$CaCl_2$	1·9805	0·2967727	·5049	$\bar{1}$·7032273
CaO	CaH_2O_2	1·3215	0·1210542	·7567	1·8789458
$CaCl_2$	Cl_2	·6393	$\bar{1}$·8057137	·1564	0·1942863
$CaCO_3$	Ca	·4001	$\bar{1}$·6021253	2·4996	0·3978747
$CaCO_3$	CO_2	·4399	$\bar{1}$·6434092	2·2730	0·3565908
$CaCO_3$	CO_3	·5999	$\bar{1}$·7781078	1·6668	0·2218922
$CaCO_3$	$CaSO_4$	1·3605	0·1337194	·7350	$\bar{1}$·8662806
$CaCO_3$	$CaSO_4$, 2aq	1·7206	0·2356874	·5812	$\bar{1}$·7643126
$CaSO_4$	Ca	·2940	$\bar{1}$·4684059	3·4009	0·5315941
$CaSO_4$	$CaSO_4$, 2aq	1·2646	0·1019680	·7907	$\bar{1}$·8980320
$CaSO_4$	SO_3	·5884	$\bar{1}$·7696535	1·6996	0·2303465
$Ca_2P_2O_8$	CaP_2O_6	·6388	$\bar{1}$·8053430	1·5655	0·1946570
$Ca_3P_2O_8$	P_2O_5	·4582	$\bar{1}$·6610091	2·1827	0·3389909
$Ca_3P_2O_8$	P_2	·2002	$\bar{1}$·3014089	·4996	0·6985911
$CaCl_2$	$CaSO_4$	1·2267	0·0887244	·8152	1·9112756
$CaCO_3$	$CaCl_2$	1·1092	0·0149950	·9016	$\bar{1}$·9550050
Carbon.					
CO_2	C	·2727	1·4357286	3·6667	0·5642714
CO_2	CO_3	1·3637	0·1346986	·7333	1·8653014
$CaCO_3$	CO_2	·4400	$\bar{1}$·6434092	2·2730	0·3565908

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
CARBON—*continued.*					
$CaCO_3$	CO_3	·5999	$\bar{1}$·7781078	1·6668	0·2218922
CO_2	Na_2CO_3	2·4115	0·3822842	·4147	$\bar{1}$·6177158
$2CO_2$	MnO_2	·9902	$\bar{1}$·9957241	1·0099	0·0042759
Carbohydrates (see p. 518).					
Chlorine.					
AgCl	Cl	·2473	$\bar{1}$·3932080	4·0438	0·6067920
AgCl	HCl	·2543	$\bar{1}$·4053162	3·9326	0·5946838
AgCl	ClO_3	·5820	$\bar{1}$·7649571	1·7181	0·2350429
AgCl	ClO_4	·6936	$\bar{1}$·8411283	1·4417	0·1588717
AgCl	Cl_2O_5	·5262	$\bar{1}$·7211948	1·9002	0·2788052
Cl	HCl	1·0283	0·0121082	·9725	$\bar{1}$·9878918
Cl	NaCl	1·6501	0·2175174	·6060	$\bar{1}$·7824826
Cl	Na	·6501	$\bar{1}$·8129983	1·5382	0·1870017
Cl	Br	2·2547	0·3530956	·4435	$\bar{1}$·6469044
Cl	I	3·5773	0·5535584	·2795	$\bar{1}$·4464416
Cl_2	O	·2256	$\bar{1}$·3533678	4·4324	0·6466322
Chromium.					
Cr_2O_3	Cr_2	·6882	$\bar{1}$·8377090	1·4531	0·1622910
Cr_2O_3	$2CrO_3$	1·3164	0·1193943	·7596	$\bar{1}$·8806057

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
CHROMIUM—*continued.*					
Cr_2O_3	$2CrO_4$	1·5258	0·1835059	·6554	$\bar{1}$·8164941
Cr_2O_3	Cr_2O_7	1·4211	0·1526321	·7037	$\bar{1}$·8473679
$PbCrO_4$	Cr	·1625	$\bar{1}$·2109600	6·1524	0·7890400
$PbCrO_4$	CrO_3	·3109	$\bar{1}$·4926453	3·2163	0·5073547
$PbCrO_4$	CrO_4	·3604	$\bar{1}$·5567569	2·7749	0·4432431
$2PbCrO_4$	Cr_2O_3	·2362	$\bar{1}$·3732510	4·2340	0·6267490
$2PbCrO_4$	Cr_2O_7	·3356	$\bar{1}$·5258831	2·9793	0·4741169
$K_2Cr_2O_7$	Cr	·3560	$\bar{1}$·5513954	2·8093	0·4486046
$K_2Cr_2O_7$	Cr_2O_3	·5172	$\bar{1}$·7136864	1·9333	0·2863136
$K_2Cr_2O_7$	$2CrO_3$	·6809	$\bar{1}$·8330807	1·4687	0·1669193
$K_2Cr_2O_7$	$2CrO_4$	·7892	$\bar{1}$·8971923	1·2671	0·1028077
$K_2Cr_2O_7$	Cr_2O_7	·7350	$\bar{1}$·8663185	1·3605	0·1336815
$BaCrO_4$	Cr	·2072	$\bar{1}$·3164705	4·8254	0·6835295
$BaCrO_4$	CrO_3	·3964	$\bar{1}$·5981558	2·5226	0·4018442
$BaCrO_4$	CrO_4	·4595	$\bar{1}$·6622674	2·1764	0·3377326
$2BaCrO_4$	Cr_2O_3	·3011	$\bar{1}$·4787615	3·3208	0·5212385
$2BaCrO_4$	Cr_2O_7	·4279	$\bar{1}$·6313936	2·3367	0·3686064
Cobalt.					
CoO	Co	·7865	$\bar{1}$·8957080	1·2714	0·1042920
$CoSO_4$	Co	·3803	$\bar{1}$·5801116	2·6296	0·4198884

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
COBALT—*continued.*					
$CoSO_4$	CoO	·4835	$\bar{1}$·6844036	2·0682	0·3155964
$Co_{21}O_{32}$	Co_{21}	·7044	$\bar{1}$·8496668	1·4136	0·1503332
Co_3O_5	Co_3	·6885	$\bar{1}$·8379195	1·4524	0·1620805
$Co_{21}O_{32}$	$7(Co_3O_5)$	1·0411	0·0117474	·9733	$\bar{1}$·9882526
$CoSO_4$	Co	·3803	$\bar{1}$·5801116	2·6296	0·4198884
$CoSO_4$	CoO	·4835	$\bar{1}$·6844036	2·0682	0·3155964
Copper.					
CuO	Cu	·7984	$\bar{1}$·9022113	1·2525	0·0977887
Cu_2S	Cu_2	·7980	$\bar{1}$·9020468	1·2530	0·0979532
Cu_2O	Cu_2	·8879	$\bar{1}$·9483591	1·1263	0·0516409
Cu_2O	$2CuO$	1·1121	0·0461478	·8992	$\bar{1}$·9538522
Cu_2S	Cu_2O	·8988	$\bar{1}$·9536877	1·1125	0·0463123
Cu_2S	$2CuO$	·9996	$\bar{1}$·9998355	1·0015	0·0001645
$CuSO_4$, 5aq	Cu	·2540	$\bar{1}$·4048318	3·9370	0·5951682
$Cu_2(CNS)_2$	Cu_2	·5216	$\bar{1}$·7173578	1·9171	0·2826422
Fluorine.					
CaF_2	F_2	·4877	$\bar{1}$·6881904	2·0502	0·3118096
CaF_2	$2HF$	·5134	$\bar{1}$·7104668	1·9477	0·2895332
$3CaF_2$	H_2SiF_6	·6174	$\bar{1}$·7905515	1·6197	0·2094482
$BaSiF_6$	F_6	·4084	$\bar{1}$·6111451	2·4482	0·3888549
$BaSiF_6$	$6HF$	·4299	$\bar{1}$·6334214	2·3258	0·3665786

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
FLUORINE—*continued.*					
$BaSiF_6$	H_2SiF_6	·5170	$\bar{1}$·7135065	1·9342	0·2864935
$BaSiF_6$	SiF_6	·5098	$\bar{1}$·7074451	1·9613	0·2925549
$BaSiF_6$	SiF_4	·3730	$\bar{1}$·5725245	2·6759	0·4274755
$BaSiF_6$	BaF_2	·6263	$\bar{1}$·7967816	1·5967	0·2032184
K_2SiF_6	F_6	·5173	$\bar{1}$·7137327	1·9332	0·2862673
K_2SiF_6	6HF	·5445	$\bar{1}$·7360090	1·8365	0·2639910
K_2SiF_6	H_2SiF_6	·6548	$\bar{1}$·8160941	1·5272	0·1839059
K_2SiF_6	SiF_6	·6457	$\bar{1}$·8100327	1·5487	0·1899673
K_2SiF_6	2KF	·5267	$\bar{1}$·7215852	1·8985	0·2784148
H_2SiF_6	F_6	·7900	$\bar{1}$·8976386	1·2658	0·1023614
H_2SiF_6	6HF	·8316	$\bar{1}$·9199149	1·2025	0·0800851
H_2SiF_6	SiF_6	·9861	$\bar{1}$·9939386	1·0141	0·0060614
H_2SiF_6	SiF_4	·7228	$\bar{1}$·8590180	1·3835	0·1409820
H_2SiF_6	2HF	·2772	$\bar{1}$·4427937	3·6075	0·5572063
Hydrogen.					
H_2O..	H	·11136	$\bar{1}$·0467237	8·9800	0·9532763
H_2	O	7·9800	0·9020029	·1253	$\bar{1}$·0979971
Iodine.					
AgI	I	·5403	$\bar{1}$·7326252	1·8509	0·2673748
AgI	HI	·5446	$\bar{1}$·7360441	1·8364	0·2639559
AgI	KI	·7070	$\bar{1}$·8494133	1·4144	0·1505867

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
IODINE—*continued.*					
AgI	IO_3	·7447	$\bar{1}$·8720031	1·3427	0·1279969
AgI	IO_4	·8129	$\bar{1}$·9100302	1·2302	0·0899698
2AgI	I_2O_5	·7107	$\bar{1}$·8516633	1·4071	0·1483367
2AgI	I_2O_7	·7788	$\bar{1}$·8914327	1·2840	0·1085673
PdI_2	I_2	·7042	$\bar{1}$·8476938	1·4201	0·1523062
PdI_2	2HI	·7098	$\bar{1}$·8511127	1·4089	0·1488873
PdI_2	$2IO_3$	·9706	$\bar{1}$·9870717	1·0302	0·0129283
PdI_2	I_2O_5	·9263	$\bar{1}$·9667319	1·0796	0·0332681
PdI_2	$2IO_4$	1·0595	0·0250988	·9438	$\bar{1}$·9749012
PdI_2	I_2O_7	1·0151	0·0065013	·9851	$\bar{1}$·9934987
TlI	I	·3832	$\bar{1}$·5834559	2·6094	0·4165441
TlI	HI	·3863	$\bar{1}$·5868748	2·5890	0·4131252
TlI	IO_3	·5282	$\bar{1}$·7228338	1·8931	0·2771662
2TlI..	I_2O_5	·5041	$\bar{1}$·7024940	1·9838	0·2975060
PbI_2	I_2	·5508	$\bar{1}$·7409758	1·8156	0·2590242
PbI_2	2HI	·5551	$\bar{1}$·7443947	1·8014	0·2556053
PbI_2	$2IO_3$	·7592	$\bar{1}$·8803537	1·3172	0·1196463
PbI_2	I_2O_5	·7245	$\bar{1}$·8600139	1·3803	0·1399861
Iron.					
Fe_2O_3	Fe_2	·7002	$\bar{1}$·8451913	1·4283	0·1548087
Fe_2O_3	2FeO	·9000	$\bar{1}$·9542667	1·1110	0·0457333

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
IRON—*continued.*					
$3Fe_2O_3$	$2Fe_3O_4$	·9667	$\bar{1}$·9852842	1·0345	0·0147158
Fe_2O_3	$2FeS$	1·1007	0·0416695	·9085	$\bar{1}$·9583305
Fe_2C_3	$2FeS_2$	1·5013	0·1764538	·6661	$\bar{1}$·8235462
$Fe_2P_2O_8$	Fe_2O_3	·5298	$\bar{1}$·7241073	1·8875	0·2758927
$Fe_2P_2O_8$	$2FeO$	·4768	$\bar{1}$·6783740	2·0971	0·3216260
$Fe_2P_2O_8$	Fe_2	·3709	$\bar{1}$·5692986	2·6959	0·4307014
FeS	Fe	·6361	$\bar{1}$·8035218	1·5721	0·1964782
FeS	FeO	·8177	$\bar{1}$·9125972	1·2229	0·0874028
$FeSO_4$, 7aq	Fe	·2015	$\bar{1}$·3042427	4·9631	0·6957573
FeS_2	Fe	·4664	$\bar{1}$·6687375	2·1442	0·3312625
Fe_2	MnO_2	·7775	$\bar{1}$·8906779	1·2862	0·1093221
FeS_2	S_2	·5336	$\bar{1}$·7272342	1·8740	0·2727658
$2FeAm_2(SO_4)_26aq$	MnO_2	·1111	$\bar{1}$·0455577	9·0041	0·9544423
$FeAm_2(SO_4)_26aq$	Fe	·1428	$\bar{1}$·1548798	7·0004	0·8451202
$K_2Cr_2O_7$	$6Fe$	1·1381	0·0561830	·8786	$\bar{1}$·9438170
Lead.					
PbO	Pb	·9282	$\bar{1}$·9676530	1·0773	0·0323470
PbO	PbS	1·0720	0·0302131	·9328	$\bar{1}$·9697869
PbO	$PbSO_4$	1·3591	0·1332665	·7358	1·8667335
PbS	Pb	·8658	$\bar{1}$·9374399	1·1559	0·0625601

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
LEAD—*continued.*					
PbS	$PbSO_4$	1·2678	0·1030534	·7888	$\bar{1}$·8969466
$PbCl_2$	Pb	·7447	$\bar{1}$·8720105	1·3427	0·1279895
$PbCl_2$	PbO	·8023	$\bar{1}$·9043575	1·2464	0·0956425
PbI_2	Pb	·4492	$\bar{1}$·6524620	2·2261	0·3475380
PbI_2	PbO	·4839	$\bar{1}$·6848090	2·0663	0·3151910
$PbSO_4$	Pb	·6829	$\bar{1}$·8343865	1·4642	0·1656135
$PbCrO_4$	Pb	·6396	$\bar{1}$·8059242	1·5634	0·1940758
$PbCrO_4$	PbO	·6891	$\bar{1}$·8382712	1·4512	0·1617288
$2PbCrO_4$	$K_2Cr_2O_7$	·4566	$\bar{1}$·6595646	2 1900	0·3404354
Lithium.					
Li_2O	Li	·4676	$\bar{1}$·6699164	2·1384	0·3300836
Li_2O	Li_2CO_3	2·4640	0·3916365	·4058	$\bar{1}$·6083635
Li_2O	$2LiCl$	2·8272	0·4513593	·3537	$\bar{1}$·5486407
Li_2CO_3	Li_2	·1898	$\bar{1}$·2782799	5·2689	0·7217201
Li_2CO_3	$2LiCl$	1·1474	0·0597228	·8715	$\bar{1}$·9402772
$LiCl$	Li	·1654	$\bar{1}$·2185571	6·0457	0·7814429
Li_2SO_4	Li_2	·1276	$\bar{1}$·1059875	·7834	0·8940125
Li_2SO_4	Li O	·2729	$\bar{1}$·4360711	3·6638	0·5639289
Li_3PO_4	Li_3	·1816	$\bar{1}$·2590182	5·5079	0·7409818
Li_3PO_4	$3LiCl$	1·0976	0·0404611	·9110	$\bar{1}$·9595389
Li_3PO_4	$3Li_2O$	·3882	1·5891018	2·5757	0·4108982

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert A into B. Factor.	A into B. Log.	B into A. Factor.	B into A. Log.
Magnesium.					
MgO	Mg	·6006	Ī·7785857	1·6650	0·2214143
MgO	$MgCO_3$	2·0983	0·3218776	·4766	Ī·6781224
MgO	$MgCl_2$	2·3709	0·3749079	·4218	Ī·6250921
MgO	$MgSO_4$	2·9985	0·4769038	·3335	0·5230962
MgO	$Mg(NO_3)_2$	3·6982	0·5679902	·2704	1·4320098
MgO	$Mg_2P_2O_7$	2·7733	0·4429926	·3606	Ī·5570074
$Mg_2P_2O_7$	Mg_2	·2166	Ī·3355931	4·6175	0·6644069
$Mg_2P_2O_7$	$2MgCO_3$	·7566	Ī·8788850	1·3216	0·1211150
$Mg_2P_2O_8$	$2MgSO_4$	1·0812	0·0339112	·9249	Ī·9660888
$Mg_2P_2O_8$	$2MgSO_4$, 7aq	2·2156	0·3455041	·4513	Ī·6544959
$MgCl_2$	Cl_2	·7467	Ī·8731317	1·3393	0·1268683
Manganese.					
MnO	Mn	·7751	Ī·8893491	1·2902	0·1106509
Mn_2O_3	Mn_2	·6967	Ī·8430656	1·4353	0·1569344
Mn_3O_4	Mn_3	·7210	Ī·8579520	1·3869	0·1420 80
MnO_2	Mn	·6328	Ī·8012430	1·5804	0·1987570
Mn	MnO_4	·4628	Ī·6654001	2·1607	0·3345999
$MnSO_4$	Mn	·3647	Ī·5619038	2·7422	0·4380962
$MnSO_4$	MnO	·4705	Ī·6725547	2·1254	0·3274453
MnO_2	Cl_2	·8138	Ī·9105454	1·2287	0·0894546

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
Mercury.					
HgS	Hg	·8640	$\bar{1}$·9365195	1·1574	0·0634805
HgS	HgO	·9330	$\bar{1}$·9698949	1·0718	0·0301051
HgO	Hg	·9260	$\bar{1}$·9666246	1·0799	0·0333754
Hg_2O	Hg_2	·9616	$\bar{1}$·9829918	1·0399	0·0170082
Hg_2O	2HgO	1·0384	0·0163672	·9630	$\bar{1}$·9836328
Hg_2Cl_2	Hg_2	·8496	$\bar{1}$·9292136	1·1770	0·0707864
Hg_2Cl_2	2HgO	·9175	$\bar{1}$·9625890	1·0900	0·0374110
Hg_2Cl_2	Hg_2O	·8835	$\bar{1}$·9462218	1·1318	0·0537782
Hg_2Cl_2	2HgS	·9833	$\bar{1}$·9926941	1·0170	0·0073059
Molybdenum.					
MoS_3	Mo	·4999	$\bar{1}$·6988794	2·0004	0·3011206
MoS_3	MoO_2	·6663	$\bar{1}$·8236596	1·5009	0·1763404
MoO_2	Mo	·7503	$\bar{1}$·8752198	1·3329	0·1247802
Am. phosphomolybdate into P		·0163	$\bar{2}$·2121876	61·350	1·7878124
Am. phosphomolybdate into P_2O_5		·0374	$\bar{2}$·5717878	26·805	1·4282122
Am. phosphomolybdate into $Ca_3P_2O_8$		·0793	$\bar{2}$·8994999	12·604	1·1005001
Nickel.					
NiO	Ni	·7859	$\bar{1}$·8953917	1·2725	0·1046083
$NiSO_4$	Ni	·3795	$\bar{1}$·5791941	2·6352	0·4208059
$NiSO_4$	NiO	·4828	$\bar{1}$·6838024	2·0711	0·3161976

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
Palladium.					
PdI_2	Pd	·2958	$\bar{1}$·4710036	3·3806	0·5289964
Phosphorus (see also Mo).					
P_2O_5	2P	·4369	$\bar{1}$·6403998	2·2888	0·3596002
P_2O_5	$2PO_4$	1·3378	0·1264072	·7475	$\bar{1}$·8735928
2P	$2PO_4$	3·0620	0·4860074	·3266	$\bar{1}$·5139926
PO_3	PO_4	1·2024	0·0800617	·8316	$\bar{1}$ 9199383
$Mg_2P_2O_7$	2P	·2794	$\bar{1}$·4461828	3·5794	0·5538172
$Mg_2P_2O_7$	P_2O_5	·6394	$\bar{1}$·8057830	1·5639	0·1942170
$Mg_2P_2O_7$	$2PO_4$	·8554	$\bar{1}$·9321902	1·1690	0·0678098
$Mg_2P_2O_7$	P_2O_7	·7834	$\bar{1}$·8940017	1·2764	0·1059983
$Mg_2P_2O_7$	$2PO_3$	·7114	$\bar{1}$·8521285	1·4056	0·1478715
$Mg_2P_2O_7$	$Ca_3P_2O_8$	1·3956	0·1447739	·7165	$\bar{1}$·8552261
$Mg_2P_2O_7$	CaP_2O_6	·8915	$\bar{1}$·9501169	1·1217	0·0498831
$Ca_2P_2O_8$	2P	·2054	$\bar{1}$·3126877	4·8676	0·6873123
$Ca_2P_2O_8$	$2PO_4$	·6290	$\bar{1}$·7986951	1·5897	0·2013049
$Ca_2P_2O_8$	P_2O_5	·4702	$\bar{1}$·6722879	2·1267	0·3277121
Ag_3PO_4	P	·0741	$\bar{2}$·8698533	13·494	1·1301467
$2Ag_3PO_4$	$2PO_4$	·2269	$\bar{1}$·3558607	4·4070	0·6441393
$2Ag_3PO_4$	P_2O_5	·1696	$\bar{1}$·2294535	5·8959	0·7705465

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
PHOSPHORUS—*contd.*					
$2Ag_3PO_4$	P_2O_7	·2078	$\bar{1}$·3176722	4·8120	0·6823278
$Ag_4P_2O_7$	$2P$	·1025	$\bar{1}$·0105927	9·7590	0·9894073
$Ag_4P_2O_7$	$2PO_4$	·3138	$\bar{1}$·4966001	3·1871	0·5033999
$Ag_4P_2O_7$	P_2O_5	·2351	$\bar{1}$·3701929	4·2639	0·6298071
$U_2P_2O_{11}$	$2P$	·08654	$\bar{2}$·9372334	11·555	1·0627666
$U_2P_2O_{11}$	P_2O_5	·1988	$\bar{1}$·2968336	5·0485	0·7031664
$U_2P_2O_{11}$	$2PO_4$	·2650	1·4232408	3·7736	0·5767592
$U_2P_2O_{11}$	P_2O_7	·2427	$\bar{1}$·3850523	4·1205	0·6149477
Platinum.					
Am_2PtCl_6	Pt	·4391	$\bar{1}$·6425203	2·2776	0·3574797
Am_2PtCl_6	$PtCl_4$	·7570	1·8791023	1·3210	0·1208977
Am_2PtCl_6	$PtCl_6$	·9186	$\bar{1}$·9631294	1·0886	0·0368706
Pt	$PtCl_4$	1·7242	0·2365820	·5800	$\bar{1}$·7634180
Pt	$PtCl_6$	2·0922	0·3206091	·4780	$\bar{1}$·6793909
K_2PtCl_6	Pt	·4009	1·6030894	2·4941	0·3969106
K_2PtCl_6	$PtCl_4$	·6913	$\bar{1}$·8396714	1·4465	0·1603286
K_2PtCl_6	$PtCl_6$	·8389	$\bar{1}$·9236985	1·1921	0·0763015
$TlPtCl_6$	Pt	·2388	$\bar{1}$·3779551	4·1884	0·6220449
Potassium.					
K_2PtCl_6	K_2	·1611	$\bar{1}$·2071564	6·2065	0·7928436
K_2PtCl_6	$2KCl$	·3071	$\bar{1}$·4872779	3·2563	0·5127221

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert A into B.		To convert B into A.	
		Factor.	Log.	Factor.	Log.
POTASSIUM—*continued.*					
K_2PtCl_6	K_2O	·1940	$\bar{1}$·2879292	5·1531	0·7120708
K_2PtCl_6	K_2SO_4	·3588	$\bar{1}$·5549162	2·7867	0·4150838
Pt	K_2	·4018	$\bar{1}$·6040670	2·4885	0·3959330
Pt	2KCl	·7659	$\bar{1}$·8841885	1·3056	0·1158115
KCl	K	·5247	1·7198785	1·9060	0·2801215
K_2O	K_2	·8303	$\bar{1}$·9192272	1·2044	0·0807728
K_2O	2KHO	1·1910	0·075905	·8396	$\bar{1}$·9240946
KCl	K_2O	·6319	$\bar{1}$·8006513	1·5825	0·1993487
KCl	Cl	·4645	$\bar{1}$·6770038	2·1038	0·3229962
K_2O	$2KNaH_4C_4O_64aq$	5·9871	0·7772189	·1670	$\bar{1}$·2227811
K_2O	$2KHC_4H_4O_6$	3·9915	0·6011354	·2505	1 3988646
K_2SO_4	K_2	·4490	$\bar{1}$·6522402	2·2272	0·3477598
K_2SO_4	K_2O	·5408	$\bar{1}$·7330130	1·8492	0·2669870
K	KHO	1·4344	0·1566782	·6971	$\bar{1}$·8433218
KNO_3	K	·3868	$\bar{1}$·5874895	2·5853	0·4125105
$2KNO_3$	K_2O	·4659	$\bar{1}$·6682623	2·1465	0·3317377
KNO_3	KCl	·7372	$\bar{1}$·8676110	1·3564	0·1323890
K_2O	K_2CO_3	1·4667	0·1663461	·6818	$\bar{1}$·8336539
$KClO_4$	K	·2824	$\bar{1}$·4508447	3·5412	0·5491553
$KClO_4$	KCl	·5382	$\bar{1}$·7309662	1·8579	0·2690338
$K_2Cr_2O_7$	K_2	·2649	$\bar{1}$·4231597	3·7744	0·5768403

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
POTASSIUM—*continued.*					
$K_2Cr_2O_7$	K_2O	·3191	$\bar{1}$·5039325	3·1338	0·4960675
$K_2Cr_2O_7$	2KCl	·5050	$\bar{1}$·7032812	1·9802	0·2967188
K_2SiF_6	K_2	·3543	$\bar{1}$·5493676	2·8225	0·4506324
K	Na	·5890	$\bar{1}$·7701236	1·6978	0·2298764
Silicon (see also F).					
SiO_2	Si	·4699	$\bar{1}$·6720456	2·1279	0·3279544
SiF_4	SiO_2	·5773	$\bar{1}$·7614565	1·7320	0·2385435
SiO_2	SiO_3	1·2650	0·1021002	·7905	$\bar{1}$·8978998
SiO_2	SiO_4	1·5301	0·1847074	·6535	$\bar{1}$·8152926
K_2SiF_6	SiO_2	·2733	$\bar{1}$·4365686	3·6596	0·5634314
K_2SiF_6	SiF_4	·4733	$\bar{1}$·6751121	2·1129	0·3248879
$BaSiF_6$	SiO_2	·2158	$\bar{1}$·3339810	·4635	0·6660190
Silver.					
AgCl	Ag	·7527	$\bar{1}$·8766273	1·3285	0·1233727
2AgCl	Ag_2O	·8066	$\bar{1}$·9066810	1·2397	0·0933190
AgBr	Ag	·5745	$\bar{1}$·7592616	1·7408	0·2407384
2AgBr	Ag_2O	·6156	$\bar{1}$·7893153	1·6244	0·2106847
AgI	Ag	·4597	$\bar{1}$·6624861	2·1753	0·3375139
2AgI	Ag_2O	·4926	$\bar{1}$·6925398	2·0298	0·3074602

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
SILVER—*continued.*					
Ag_3PO_4	3Ag	·7731	$\bar{1}$·8882281	1·2905	0·1117719
$Ag_4P_2O_7$	4Ag	·7126	$\bar{1}$·8528762	1·4032	0·1471238
AgCN	Ag	·8056	$\bar{1}$·9061179	1·2413	0·0938821
2AgCN	Ag_2O	·8653	$\bar{1}$·9371716	1·1557	0·0628284
Ag_2O	Ag	·9309	$\bar{1}$·9689463	1·0741	0·0310537
Ag	Cl	·3285	$\bar{1}$·5165807	3·0438	0·4834193
Sodium.					
NaCl	Na	·3940	$\bar{1}$·5954809	2·5382	0·4045191
2NaCl	Na_2O	·5307	$\bar{1}$·7248588	1·8843	0·2751412
NaCl	$NaHCO_3$	1·4366	0·1573247	·6961	$\bar{1}$·8426753
2NaCl	Na_2CO_3	·9067	$\bar{1}$·9574673	1·1029	0·0425327
2NaCl	Na_2SO_4	1·2149	0·0845244	·8231	$\bar{1}$·9154756
Na_2O	Na_2	·7424	$\bar{1}$·8706221	1·3470	0·1293779
Na_2O	Na_2SO_4	2·2891	0·3596656	·4368	$\bar{1}$·6403344
Na_2O	Na_2CO_3	1·7085	0·2326085	·5853	$\bar{1}$·7673915
Na_2O	2NaHO	1·2899	0·1105598	·7752	$\bar{1}$·8894402
Na_2O	$2NaNO_3$	2·7404	0·4378196	·3649	$\bar{1}$·5621804
NaHO	Na	·5755	$\bar{1}$·7600623	1·7376	0·2399377
Na_2CO_3	Na_2CO_3, 10aq	2·6969	0·4308650	·3708	$\bar{1}$·5691350
Na_2CO_3	Na_2	·4345	$\bar{1}$·6380136	2·3014	0·3619864

A.	B.	To convert A into B. Factor.	A into B. Log.	B into A. Factor.	B into A. Log.
SODIUM—*continued.*					
Na_2SO_4	Na_2	·3243	$\bar{1}$·5109565	3·0835	0·4890435
$Na_2H_2Sb_2O_7$	Na_2	·1151	$\bar{1}$·0609184	8·6913	0·9390816
Strontium.					
$SrCO_3$	Sr	·5932	$\bar{1}$·7732539	1·6856	0·2267461
$SrCO_3$	SrO	·7017	$\bar{1}$·8461718	1·4251	0·1538282
$SrCO_3$	$SrCl_2$	1·0740	0·0310067	·9311	$\bar{1}$·9689933
$SrSO_4$	Sr	·4767	$\bar{1}$·6782784	2·0976	0·3217216
$SrSO_4$	SrO	·5638	$\bar{1}$·7511963	1·7734	0·2488037
$SrSO_4$	$SrCl_2$	·8630	$\bar{1}$·9360312	1·1587	0·0639688
$SrSO_4$	$SrCO_3$	1·2444	0·0949755	·8035	$\bar{1}$·9050245
SrO	Sr	·8454	$\bar{1}$·9270821	1·1828	0·0729179
$SrCl_2$	Sr	·5523	$\bar{1}$·7422472	1·8103	0·2577528
SrCl	SrO	·6534	$\bar{1}$·8151651	1·5305	0·1848349
$Sr(NO_3)_2$	Sr	·4136	$\bar{1}$·6165671	2·4179	0·3834329
$Sr(NO_3)_2$	SrO	·4892	$\bar{1}$·6894850	2·0441	0·3105150
Sulphur (see also Ba).					
$BaSO_4$	S	·1375	$\bar{1}$·1382314	7·2739	0·8617686
$BaSO_4$	SO_2	·2747	$\bar{1}$·4388538	3·6404	0·5611462
$BaSO_4$	SO_3	·3433	$\bar{1}$·5356822	2·9128	0·4643178

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
SULPHUR—*continued.*					
$BaSO_4$	SO_4	·4119	$\bar{1}$·6148091	3·4277	0·3851909
$BaSO_4$	H_2S	·1461	$\bar{1}$·1645763	6·8458	0·8354237
$BaSO_4$	H_2SO_4	·4205	$\bar{1}$·6237806	2·3780	0·3762194
$2BaSO_4$	FeS_2	·2576	$\bar{1}$·4109972	3·8816	0·5890028
S	H_2SO_4	3·0588	0·4855492	·3269	$\bar{1}$·5144508
SO_3	H_2SO_4	1·2249	0·0880984	·81640	$\bar{1}$·9119016
S	SO_2	1·9981	0·3006224	·5005	$\bar{1}$·6993776
S	SO_3	2·4972	0·3974508	·4005	$\bar{1}$·6025492
SO_2	SO_3	1·2498	0·0968284	·8001	$\bar{1}$·9031716
S	SO_4	2·9962	0·4765777	·3337	$\bar{1}$·5234223
S	H_2SO_4	3·0588	0·4855492	·3269	$\bar{1}$·5144508
H_2S	SO_2	1·8805	0·2742775	·5317	$\bar{1}$·7257225
As_2S_3	$3S$	·3904	$\bar{1}$·5915238	2·5614	0·4084762
As_2S_3	$3H_2S$	·4148	$\bar{1}$·6178688	2·4106	0·3821312
CdS	S	·2225	$\bar{1}$·3474822	4·4928	0·6525178
CdS	H_2S	·2365	$\bar{1}$·3738271	4·2284	0·6261729
SO_3	$CaSO_4$	1·6996	0·2303465	·5884	$\bar{1}$·7696535
SO_3	$CaSO_4$, 2aq	2·1494	0·3323145	·4652	$\bar{1}$·6676855
SO_3	Na_2SO_4	1·7757	0·2493776	·5631	$\bar{1}$·7506224
Tin.					
SnO_2	Sn	·7882	$\bar{1}$·8966455	1·2687	0·1033545

FACTORS AND THEIR LOGARITHMS, ETC.—*continued.*

A.	B.	To convert			
		A into B.		B into A.	
		Factor.	Log.	Factor.	Log.
Titanium.					
TiO_2	Ti	·6001	1·7782238	1·6664	0·2217762
TiO_2	TiO_3	1·2000	0·0791631	·8333	$\bar{1}$·9208369
TiO_2	TiO_4	1·3999	0·1460970	·7143	$\bar{1}$·8539030
Tungsten.					
WO_3	W	·7932	$\bar{1}$·8993592	1·2608	0·1006408
Uranium.					
W_3O_8	U_3	·8488	$\bar{1}$·9288270	1·1781	0·0711730
$U_2P_2O_{11}$	U_2	·6681	$\bar{1}$·8248304	1·4968	0·1751696
$U_2P_2O_{11}$	$2UO_2$	·7573	$\bar{1}$·8792736	1·3205	0·1207264
$K_2U_2O_7$	U_2	·7158	$\bar{1}$·8547815	1·3971	0·1452185
Vanadium.					
V_2O_5	V_2	·5620	$\bar{1}$·7497516	1·7793	0·2502484
Zinc.					
ZnO	Zn	·8036	$\bar{1}$·9050364	1·2444	0·0949636
$ZnCl_2$	Zn	·4800	$\bar{1}$·6812466	2·0833	0·3187534
ZnS	Zn	·6713	$\bar{1}$·8268896	1·4897	0·1731104
ZnS	ZnO	·8355	$\bar{1}$·9218532	1·1971	0·0781468
Zirconium.					
ZrO_2	Zr	·7382	$\bar{1}$·8681675	1·3547	0·1318325

* For factors used in Volumetrical Analysis, *vide* pp. 403 et seq.

STÖCHIOMETRY, OR CHEMICAL CALCULATIONS.

Conversion of Thermometer Degrees.

°C to °R, multiply by 4 and divide by 5.
°C to °F, multiply by 9, divide by 5, then add 32.
°R to °C, multiply by 5 and divide by 4.
°R to °F, multiply by 9, divide by 4, then add 32.
°F to °R, first subtract 32, then multiply by 4, and divide by 9.
°F to °C, first subtract 32, then multiply by 5, and divide by 9.

To find the Percentage Composition having the Formula given.

Find the molecular weight from the formula, then

$$\frac{\text{Molecular weight}}{100} = \frac{\text{Weight of constituent in a molecule.}}{\text{Percentage of constituent.}}$$

Or we may proceed thus:

Multiply the atomic weight of the element by 1, 2, 3, &c., according to the number of atoms of the element there are in the molecule; multiply the number thus obtained by 100, and divide by the molecular weight.

To find the Weight of any Element contained in any given Weight of a Compound Substance.

$$\frac{\text{Molecular weight}}{\text{Given weight}} = \frac{\text{Weight of constituent in a molecule.}}{\text{Required weight.}}$$

Or, multiply the atomic weight of the element by 1, 2, 3, &c., according to the number of atoms of the element there are in the molecule; multiply the number thus obtained by the given weight, and divide by the molecular weight.

To find the Empirical Formula of a Body from its Percentage Composition.

Divide the percentage of each element by the atomic weight of that element to three places of decimals, and divide all the numbers thus obtained by the lowest; if the quotients are not whole numbers, reduce them to their simplest relation in whole numbers, and to these whole numbers prefix the symbol to which each refers.

To find the Weight of a Substance required to yield, liberate, or produce, a given Weight of a Substance.

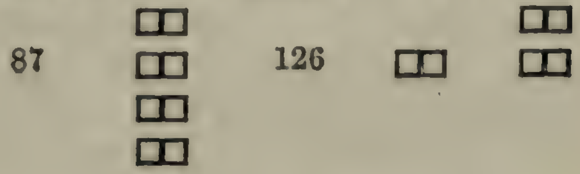
Write the equation expressing the chemical change; then

$$\begin{array}{c}\text{Molecular weight}\\\text{of resulting sub-}\\\text{stance} \times \text{Number}\\\text{of molecules}\\\text{involved}\end{array} : \begin{array}{c}\text{Quantity}\\\text{of}\\\text{resulting}\\\text{substance}\\\text{given}\end{array} :: \begin{array}{c}\text{Molecular weight}\\\text{of original sub-}\\\text{stance} \times \text{Number}\\\text{of molecules}\\\text{involved}\end{array} : \begin{array}{c}\text{Weight}\\\text{of origi-}\\\text{nal sub-}\\\text{stance}\\\text{required}\end{array}$$

To solve Problems involving Volumes of Gases.

Write the equation expressing the chemical change, and underneath the gaseous product write the sign □□ for each molecule (if there are more than one), thus:

$$MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2OH_2$$



4 volumes of hydrochloric acid gas yield 1 volume of chlorine and 2 volumes of water vapour. Any problem is readily solved by this method with the aid of simple proportion. The following data must be borne in mind.

An atomic weight of an element taken in grams occupies 11·2 litres, at 0° C. and 760 mm. pressure, but As and P occupy 5·6 litres, and Hg occupies 22·4 litres.

A molecular weight of a compound taken in grams occupies 22·4 litres, unless the vapour density compound is abnormal.

1 litre of hydrogen weighs 1 crith = ·0896 gram.

FORMULA FOR CORRECTING THE VOLUME OF GASES FOR TEMPERATURE AND PRESSURE.

V = original volume.
V' = corrected volume.
t = original temperature C°.
t' = final temperature C°.
P = original pressure.
P' = final pressure.

$$\frac{V}{V'} = \frac{(273 + t)}{(272 + t')} \frac{P'}{P}.$$

SECTION III.

WEIGHTS AND MEASURES.

The Imperial System.

(*General in the British Empire.*)

By the Weights and Measures Act of 1878, the **yard** is defined as the distance at 62° F. (= 16°·667 C.) between two lines marked on a solid square bar of bronze, and the **Avoirdupois pound** (lb.) is the weight in vacuo of a cylinder of platinum. This bar and cylinder were originally established by the Standards Act of 1855, as the Imperial standard yard and the Imperial standard Avoirdupois pound, and certain copies of both were ordered to be made, from which, by the Act of 1878, in case the original standards should be lost or injured, new ones could be prepared.

The **gallon** is determined by the Imperial standard gallon measure, a brass vessel which contains 10 avoirdupois pounds' weight of distilled water, weighed in air against brass weights at 62° F., and 30 inches bar. pressure. The Imperial gallon is the unit of capacity for liquids and dry goods (e.g. corn, &c.).

The weight of a given volume of water was not fixed by the Act of 1878, although defined by an older Act of 1824, but in the Sale of Gas Act of 1859, the weight of a cubic inch of distilled water is taken as 252·458 grains, according to which the Imperial gallon was taken as containing 277·27384 cubic inches. More recent and accurate determinations with air-free water show the Imperial gallon to contain 277·463 cubic inches.

Certain ancient and now obsolete gallon measures are still of interest in connection with the measures of the United States of America. In addition to the weights and measures defined above, others are still legal for special purposes.

The Metric System.

The metric standards of length and weight were originally referred to natural constants, as were also formerly the yard and pound. The **metre** (M) was defined as the $\frac{1}{40000000}$th part of the quadrant of the meridian at Paris, and the **gramme** was the weight of a cubic centimetre of water at 4° C. The standard metre and the standard kilogramme are now, however, defined for purposes of accuracy, by reference to actual hand-made standards prepared by the International Committee of Weights and Measures, Paris. The metre is determined by the distance, at 0° C., between two lines marked on a bar of iridio-platinum, and the kilogramme by the weight in vacuo at 0° C. of a cylinder of the same alloy. The **litre** is the measure of volume, and is determined by reference to the volume of a kilo. of water at 4° C., the temperature of maximum density of this liquid.

The equivalence of the metre in inches was fixed by the Act of 1878, as 39·37079 inches, from determinations made in 1818; and the equivalence of the pound in grammes was fixed as 453·59265, from a comparison made in 1844. In the subsequent tables, the equivalents given are those derived from later and more accurate determinations made under the directions of the Board of Trade and the International Committee of Weights and Measures, but for almost all purposes the differences are too slight to be of any importance.

System of the U.S. of America.

In the United States of America, the **international metre** and **kilogramme** are regarded as the standards of length and mass, but the yard and pound are also in use, and considered as derived from the international metric standards.

The U.S. yard (= 0·9143992 M) is identical with the Imperial yard. The troy pound and the avoir. pound are both in use in U.S.A., and are identical with the English troy pound (no longer legal here), and with the Imperial pound. A ton of 2000 lbs. avoir. is used for some purposes in the U.S.A. The unit of capacity for corn measure in the U.S.A. is the old Winchester bushel, containing 2150·42 cubic inches or 0·96944 Imperial bushel, of Henry VII. (1495) (still sometimes used in England for fixing corn rents); and the standard gallon is apparently the old (Queen Anne's, 1707) wine gallon of 231 cubic inches, stated to contain 8·3389 lbs. of distilled water at 39°·83 F., and 8·3292 lbs. at 62° F. The gallon is defined in the Pharmacopœia of U.S.A. as containing 8 pints, each equal to 7291·2 grains of distilled water at 60° F. (i.e. gallon equals 8·3328 lbs. of water).

MEASURES OF LENGTH.

Linear Measure, Imperial.

With Metrical Equivalents.

Ins.	Feet.	Yards.	Fath.	Poles.	Furl.	Mile.	Metres.
1	·083	·02778	·0139	·005	·000126	·0000158	·02539998
12	1	·333	·1667	·0606	·00151	·0001894	·3047997
36	3	1	·5	·182	·00454	·000568	·9143992
72	6	2	1	·364	·0091	·001136	1·8287984
198	16½	5½	2¾	1	·025	·003125	5·0291956
7920	660	220	110	40	1	·125	201·167824
63360	5280	1760	880	320	8	1	1609·34259

(12 lines = 1 inch)

Linear Measure, Metric.

With Imperial Equivalents.

The recognised International Symbols are given in brackets.

		Imp. Inches.	Imp. Feet.	Imp. Yards.	Imp. Fath.	Imp. Miles.
1 Micron (μ)	·001 mm.	·00004				
1 Millimetre (mm.)	·001 m.	·0393701	·00328084	·00109361	·00054681	·0000006
1 Centimetre (cm.)	·01 m.	·39370113	·03280843	·01093614	·00546807	·000006
1 Decimetre (dm.)	·1 m.	3·9370113	·32808428	·109361426	·05468071	·000062
1 Metre (m.)	1 m.	39·370113	3·2808428	1·09361426	·54680713	·000621
1 Decametre (dam.)	10 m.	393·70113	32·808428	10·9361426	5·4680713	·006214
1 Hectometre (hm.)	100 m.	3937·0113	328·08428	109·361426	54·680713	·062137
1 Kilometre (km.)	1000 m.	39370·113	3280·8428	1093·61426	546·80713	·621371
1 Myriametre	10,000 m.	393701·13	32808·428	10936·1426	5468·0713	6·21371

MEASURES OF WEIGHT.

Avoirdupois Weight, Imperial.

With Metrical Equivalents.

Drachms.	Oz.	Lbs.	Qrs.	Cwts.	Ton.	Grammes.
1=	·0625=	·0039=	·000139=	·000035=	·00000174=	1·77185
16=	1=	·0625=	·00223	=·000558=	·000028	=28·34953
256=	16=	1=	·0357	=·00893	=·000447	=453·59243
7168=	448=	28=	1	=·25	=·0125	=12,700·588
28672=	1792=	112=	4	=1	=·05	=50,802·35216
573440=	35840=	2240=	80	=20	=1	=1,016,047·0432

(1 dram=27·34375 grains). (1 lb.=7000 grains).
(1 oz.=437·5 grains). (14 lbs.=1 stone).

Troy Weight.

1 Troy grain = 1 Avoirdupois grain.

Grains.	Dwts.	Oz.	Lb.	Grammes.
1=	·04167=	·00208=	·0001736=	·06479891824
24=	1	=·05	=·004167	
480=	20	=1	=·0833	=31·10348
5760=	240	=12	=1	

175 lbs. troy=144 lbs. avoirdupois.
lbs. avoirdupois × 1·2153 =lbs. troy.
lbs. troy .. × ·82286=lbs. avoirdupois.

The lb. troy is no longer a legal weight, but the Weights and Measures Act, 1878, authorises the sale of precious metals and stones by the troy ounce, or by any decimal part of such ounce.

Apothecaries' Weight.

The Weights and Measures Act, 1878, s. 20, provides that "Drugs, when sold retail, may be sold by apothecaries' weight," but the British Pharmacopœia of 1885 recognises only Imperial avoirdupois weight (and also Metric weights in analysis).

1 Grain (gr.) = ·0647989 grammes.
1 Scruple ℈ = 20 grs.= 1·295978 „
1 Drachm ʒ = 3 ℈= 60 grs.= 3·887935 „
1 Ounce Troy ℥=8 ʒ=24 ℈=480 grs.=31·10348 „

The scruple and drachm are still used in medical prescriptions.

MEASURES OF WEIGHT—*continued.*

Weights, Metric.

With Imperial Equivalents.

The recognised International Symbols are given in brackets.

		Imp Grains.	Imp. Av. Oz.	Imp.Av.Lbs.	Imp. Cwts.	Imp. Tons.
1 Milligramme (mg.)	·001 g.	·015432356	·00003	·0000022	·00000002	·000000000
1 Centigramme (cg.)	·01 g.	·1543235639	·00035	·0000220	·00000020	·00000000
1 Decigramme (dg.)	·1 g.	1·543235639	·00353	·00022046	·00000197	·0000001
1 Gramme (g.)	1 g.	15·43235639	·03527	·00220462	·00001968	·0000010
1 Decagramme (dag.)	10 g.	154·3235639	·35274	·02204622	·00019684	·0000098
1 Hectogramme (hg.)	100 g.	1543·235639	3·5274	·2204622	·00196841	·0000984
1 Kilogramme (kg.)	1000 g.	15432·35639	35·274	2·204622	·01968413	·0009842
1 Myriagramme	10 kg.	154323·5639	352·74	22·04622	·19684128	·0098421
1 Quintal (q.)	100 kg.	1543235·639	3527·4	220·4622	1·9684128	·0984206
1 Millier or Tonne (t)	1000 kg.	15432356·39	35274	2204·622	19·684128	·9842064

MEASURES OF SURFACE.

Square Measure, Imperial.

With Metrical Equivalents.

Inches.	Feet.	Yards.	Perches.	Roods.	Acre.	Metrical.
1	·00694	·000772	·0000255	·00000064	·000000159	6·451589 cm².
144	1	111	·00367	·0000918	·000023	·0929029 m².
1296	9	1	·0331	·000826	·0002062	·836126 m².
39204	272¼	30¼	1	·025	·00625	25·29281 m².
1568160	10890	1210	40	1	·25	1011·7123 m².
6272640	43560	4840	160	4	1	404·6849 m².

1 Sq. Mile = 640 Acres = 2589983·6 m.

Square Measure, Metric.

With Imperial Equivalents.

The recognised International Symbols are given in brackets.

1 Sq. Centimetre (cm^2)=·0001 m^2=·155 Sq. Inch.
1 Sq. Decimetre (dm^2)=·01 m^2=15·5.. Sq. Inches.
1 Sq. Metre (m^2) = { 1550·006 Sq. Inches.
10·763929 Sq. Feet.
1·1959921 Sq. Yard.
1 Sq. Decametre (dam^2)=100 m^2.
1 Sq. Hectometre or 100 Ares } =10,000 m^2=2·471058 Acres.

MEASURES OF VOLUME.

Cubic Measure, Imperial.

With Metrical Equivalents.

Ins.	Feet.	Yard.	Metrical.
1=	·0005788=	·000002144=	16·38702 cm^3=·02883 pints
1728=	1	= ·03704	=·02831677 m^3=6·228 galls.
46656=	27	=1	=·76455285 m^3

1 cub. inch of water (62° F.) weighs	252·286 grs.
1 ” ” ” ”	·57665 oz. av.
1 ” ” ” ”	·036041 lb. av.
1 cub. foot ” ” ”	996·458 oz. av.
1 ” ” ” ”	62·2786 lbs. av.
1 ” ” ” ”	28·2491 kilogs.
1 cub. yard ” ” ”	·75068 ton.

Cubic Measure, Metric.

With Imperial Equivalents.

The recognised International Symbols are given in brackets.

1 Cub. Centimetre (cm^3)=·000001 m^3=·061... Cub. Inch.
1 Cub. Decimetre (dm^3)=·001 m^3=61·0239 Cub. Inches.
1 Cub. Metre (m^3)= { 61023·90 Cub. Inches.
35·3147589 Cub. Feet.
1·3079540 Cub. Yard.

MEASURES OF CAPACITY.

With Metrical Equivalents.

Pints.	Gall.	Peck.	Bushel.	Quarter.	Wey.	Last.	Cub. Ft.	Litres.
1	·125	·0625	·01562	·00195	·00039	·000195	·02	·56825
8	1	·5	·125	·0156	·00312	·00156	·1606	4·5459631
16	2	1	·25	·03125	·00625	·00312	·3211	9·09193
64	8	4	1	·125	·025	·0125	1·284	36·3677
512	64	32	8	1	·2	·1	10·276	230·942
2560	320	160	40	5	1	·5	51·382	1454·71
5120	640	320	80	10	2	1	102·76	2909·42

1 (Imp.) gill = ¼ pint = 1·42061 dl.; in some localities 1 gill = ½ pint.

1 pint = 34·6829 cub. inches = ·02007 cub. foot.

1 gallon in wine, ale, or dry measure
= 277·463 cubic inches = ·16057 cub. foot
= 10 lbs. of distilled water = 70,000 grs. water (62° F.).

Cubic feet × 6·228 = gallons.

Cubic ins. × ·003604 = gallons.

1 bushel = 2219·7 cube inches = 1·28 cube foot.

Cubic feet × ·778 = bushels.

Cubic ins. × ·00045 = bushels.

4 quarters = 1 chaldron.

The Measures of Capacity official in the B.P.

Imperial measures are used.

1 Minim, min. (or ♏) .. .. = ·059 cm^3
1 Fluid Drachm, fl. drm. (or fl. ʒ) = 60 ♏ = 3·551 „
1 Fluid Ounce, fl. oz. (or fl. ℥)
= 8 fl. ʒ = 480 ♏ = 28·412 „
1 Pint, O (or pint)
= 20 fl. ℥ = 160 fl. ʒ = 9600 ♏ = 568·25 „
1 Gallon, (C) (or gall.)
= 8 pints = 160 fl. ℥, = 1280 fl. ʒ = 75800 ♏ = 4545·9631 „

These measures, with the exception of the ♏ and the fl ʒ. are directly connected with the avoirdupois weights. Thus the fl. ℥ is the measure of 1 oz. of aq., the pint is the measure of 1¼ lb. of water. and the gall. the measure of 10 lbs. of aq., in all cases at 62° F. (16·66° C.). The fl. ℥ being the measure of 1 oz. (i e. of 437·5 gr. of aq.), and 437·5 being a number not susceptible of convenient subdivision into aliquot parts, the ♏ has been introduced by analogy with apothecaries' weight, in which system the oz. is larger than the oz.

avoirdupois, and contains 480 gr. The minim is the measure of $\frac{1}{480}$ of an oz. avoirdupois of water. It is not the measure of 1 gr. of water, but the measure of ·9114583 gr. of aq. It is *important to note this difference.* 1 pint is the measure of 1·25 lb. of water (62° F.), 1 gall. of 70,000 grs., 1 gr. measure $=1{\cdot}09\dot{7}1428\dot{5}$ ♏

The Measures of Capacity official in the U.S.P.

These are quite distinct from the Measures of Capacity official in the B.P. In the first place the gall. is quite different; the old wine gall. containing 58372·2 gr. of distilled aq. of max. density weighed in air at 62° F., and 30 in. bar. pressr. being adopted. The pint is the eighth part of this, and it is divided into 16 fl. ℥ (not 20). There are 480 min. in an ounce, and the min. is larger than the ♏ of the B.P.

1 *Minim* .. ..= ·0616 cm³
1 *Fluid Drachm* .. .. ..= 60 *min.* = 3·75 „
1 *Fluid Ounce* .. = 8 fl. ʒ = 480 *min.* = 29·57 „
1 *Pint* = 16 fl. ℥ = 128 fl. ʒ = 7680 *min.* = 473·11 „
1 *Gallon*
=8 pints=128 fl. ℥ =1024 fl. ʒ =61440 *min.* =3785·00 „

Measures of Capacity, Metrical.

With Imperial Equivalents.

The recognised International Symbols are given in brackets.

1 Microlitre = ·001 ml.
* 1 Millilitre (ml.) = ·001 l. = { 16·891 ♏. ·028152 fl. ʒ. 35·1960 fl. ℥.
1 Centilitre (cl.) = ·01 l. =
1 Litre = { 35·196 fl. ounces. 1·7598 pints. ·219975 gallon. ·0274969 bushel.
1 Decalitre (dal.) = 10 l. =
1 Hectolitre = 100 l =
1 Kilolitre = 1000 l. =

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* The ml. and the cm³ are for practical purposes identical, but since the standard kilogramme if lost would be restored by reference to the copies deposited with the various States which have joined the Metric Convention of 1871, and not with reference to the weight of water; and the standard litre if lost would be restored by reference to a kilo-

gramme weight of water, and would not depend upon the weight of a dm^3 of water; it is better that densities and volumes should be expressed in litres and parts of a litre than in cub. centimetres, but for convenience cm^3 has been used for ml in stating equivalence in these tables.

Wine Measure.

pints
2 = 1 quart.
8 = 4 = 1 gallon.
336 = 168 = 42 = 1 tierce.
504 = 252 = 63 = 1½ = 1 hogshead.
672 = 336 = 84 = 2 = 1⅓ = 1 puncheon.
1008 = 504 = 126 = 3 = 2 = 1½ = 1 pipe or butt.
2016 = 1008 = 252 = 6 = 4 = 3 = 2 = 1 tun.

Ale and Beer Measure.

pints
2 = 1 quart.
8 = 4 = 1 gallon.
72 = 36 = 9 = 1 firkin.
144 = 72 = 18 = 2 = 1 kilderkin.
288 = 144 = 36 = 4 = 2 = 1 barrel.
432 = 216 = 54 = 6 = 3 = 1½ = 1 hogshead.
576 = 288 = 72 = 8 = 4 = 2 = 1⅓ = 1 puncheon.
864 = 432 = 108 = 12 = 6 = 3 = 2 = 1¼ = 1 butt.

The old ale barrel of 32 gallons is still in use in Ireland.

Parts per 100,000 × 0·7 = grains per gallon.
Grains per gallon ÷ 7 = parts per 100,000.
Grains per gallon × 0·0143 = g. per l.
Grains per gallon × 1·2755 = cwts. per million gallons.
G. per l. × 70 = grains per gallon.
G. per l. × 437 = grains per cubic foot.
G. per l. × ·43847 = grains per fl. ounce.
G. per l. × ·06243 = lbs. per cubic foot.
G. per l. × ·999 = ounces per cubic foot.
L. × ·0353 = cubic feet.
Percentage × 4·375 = grains per fl. ounce.
Grains per fl. ounce × 0·2286 = percentage.
Lbs. per sq. in. × 0·0703 = kg. per cm^2.
Kg. per cm^2 × 14·223 = lbs. per sq. in.

TABLE SHOWING THE EQUIVALENCE OF WEIGHTS AND MEASURES.

Contributed by Mr. G. M. JONES.

1 lb. avoirdupois = 1 lb. = 16 oz. = 7000 grains = 453·59 grammes
= 1·2152$\dot{7}$ ℔. troy
1 ℔. apoth. or troy = 1 ℔. = 12 ℥ = 5760 grains = 373·242 grammes
= 0·8$\dot{2}$28571$\dot{4}$ lb. avoir.
1 oz avoir. = 1 oz. = 437·5 grains = 28·35 grammes
= 0·9114583 ℥
1 ounce apoth. or troy = 1 ℥ = 480 grains = 31·80 grammes
= 1·0973714 oz.
1 dram avoir. = 27·34375 grains = 1·77184 grammes
= drachm apoth. ·455729
1 drachm apoth. or troy = 1 ʒ = 3 ℈ (scruples) = 60 grains
= drams avoir. 2·1942857
= 3·88752 grammes
1 pint = O = 20 ℥ fl. = The volume occupied by 20 oz. avoir. of water at 60° F. = 15·5° C.
1 fluid oz. = ℥ fl. i = The volume occupied by 1 oz. avoir. of water at 60° F. = $\frac{1}{20}$th pint
1 fluid drachm = ʒ fl. i = 60 minims = 54·6875 grain measures
= 3·519 c.c.

1 minim = ·911458$\dot{3}$ grain measure = ·0591583 c c.
1 grain measure = 1·09$\dot{7}$1428$\dot{5}$ minim = the vol. occupied by 1 gr. of water at 60° F. = 15·5 C.

1 cub. cent. = 1 cm^3 = ʒ fl. ·282
1 " " " = cub. inch ·0610270734
1 " " " = ℥ fl. ·0352
1 " " " = pint ·00176

1 cub. foot = cm^3 28315·3
1 " " = gallons 6·2321
1 " " = litres 28·3153
1 " " = oz fl. 997·1364
= pints 49·8568

EQUIVALENCE OF WEIGHTS AND MEASURES—*continued.*

1 gallon = cub. ft. ·16046
1 „ = cub. inch 277·274
1 „ = litre 4·54346

1 cub. inch = cm^3 16·386
1 „ „ = ʒ fl. 4·616
1 „ „ = gallon ·00360654
1 „ „ = litre ·0164
1 „ „ = ℥ fl. ·577
1 „ „ = pint ·02885

1 litre = ʒ fl. 281·85
1 „ = cub. ft. ·035316
1 „ = gallon ·220096
1 „ = cub. inch 61·0270
1 „ = ℥ fl. 35·23
1 „ = pint 1·761

1 oz. fl. = cm^3 28·396
1 „ = cub. inch 1·7329

1 pint = cm^3 567·919
1 „ = cub. ft. ·020057
1 „ = cub. inch 34·659
1 „ = litre ·567920

1 gramme = lb. ·002204
1 „ = oz. ·03527
1 „ = ℔ ·002679
1 „ = ℥ ·03215
1 „ = dram ·564357
1 „ = ʒ ·2572
1 „ = grains 15·432348

1 grain avoir. = 1 grain apoth. or troy
1 „ = gramme ·064792
1 „ = lb. ·000$\dot{1}$4285$\dot{7}$
1 „ = ℔ ·0001738$\dot{1}$

EQUIVALENCE OF WEIGHTS AND MEASURES—*continued.*

1 mile per unit of time = 1·609315 kilometres per same unit
1 ,, ,, hour = ·44703 metre per second
1 ,, ,, ,, = 26·8219 metres per minute

1 gramme per sq. cent. = ·2275632 oz. avoir. per sq. inch
1 ,, ,, ,, = 32·7691 oz. avoir. per sq. foot
1 ,, ,, ,, = 0·0142227 lb. avoir. per sq. inch
1 kilo. per sq. decimetre = 2·2756 oz. avoir. per sq. inch
1 gramme per sq. cent. = 2·0480688 lb. avoir. per sq. foot
1 cwt. per sq. inch = 7874·675 grammes per sq. cent.
1 ,, ,, foot = 5468·52432 grammes per sq. decim.
1 lb. av. per sq. inch = 70·3096 grammes per sq. cent.
1 ,, ,, foot = 48·82611 grammes per sq. cent.
1 calorie = 1 kilo. of water raised 1° C.

1 Centigrade thermal unit = 1 lb. avoir. raised 1° C.
1 Fahr. therm. unit = 1 lb. avoir. raised 1° F.
1 kilogrammetre = 1 kilogramme raised 1 metre
1 foot-pound = 1 lb. avoir. raised 1 foot

1 calorie = cent. therm. units 2·20462
1 ,, = Fahr. ,, ,, 3·96832
1 ,, = foot-pounds 3066·85127
1 ,, = kilogrammetres 424·00000

1 cent. therm. unit = calorie ·45359
1 ,, ,, ,, = Fahr. therm. unit 1·80000
1 ,, ,, ,, = kilogrammetres 192·32329
1 ,, ,, ,, = foot-pounds 1391·10127

1 Fahr. therm. unit = calorie ·25199
1 ,, ,, ,, = cent. therm. unit ·555...
1 ,, ,, ,, = kilogrammetres 106·84627
1 ,, ,, ,, = foot-pounds 772·83404

1 kilogrammetre = calorie ·0023585
1 ,, = cent. therm. unit ·0051996
1 ,, = Fahr. therm. unit ·0093592
1 ,, = foot-pounds 7·2331398

EQUIVALENCE OF WEIGHTS AND MEASURES—*continued*.

1 foot-pound = calorie ·000326067
1 " = cent. therm. unit ·000718855
1 " = Fahr. therm. unit ·001293845
1 " = kilogrammetre ·138252542

1 horse-power = cheval-vapeur 1·0134$\dot{6}$.
1 " = foot-pound per sec. 550
" = " " min. 33000
" = kilogrammetre per sec. 76·01
" = " " min. 4560·6

cheval-vapeur = horse-power ·986712
" = foot-pounds per sec. 542 485
" = " " min. 32549·1291
1 " = kilogrammetre per sec. 75·0000..
" = " " min. 4500·0...

1 kilogrmtr. per second = cheval-vapeur ·01$\dot{3}$...
1 " " " = horse-power ·0135126
1 " " minute = cheval-vapeur ·000$\dot{2}$...
1 " " " = horse-power ·0002252

This table was calculated by the late Mr. G. M. Jones before the latest determinations of equivalence between Imperial and Metric weights and measures had been published, but the differences are too slight to be of any consequence (see note on pp. 95, 96).

For weights of British coins, *vide* p. 538.

Weights of U.S. coins:—

	Grains.		Grains.
Dollar	412½	Five-cent piece ..	77·16
Half-dollar ..	192	Three-cent piece ..	32
Quarter-dollar..	96	One-cent piece ..	48
Dime..	10		

ELECTRICAL MEASUREMENTS.

Units.

By an Order in Council dated Aug. 23, 1894, various electrical standards, viz. the ohm, ampère and volt, for use in trade, were defined as follows:—

Resistance.

OHM. The resistance offered at 0° C. to an unvarying electric current by a column of mercury 14·4521 grammes in mass of a constant cross-sectional area (which is 1 sq. mm.), and of a length of 106·3 centimetres, is adopted as one *ohm*. The B.A. unit = ·9866 ohm. The actual standard ohm is a bar of metal of which copies have been made, as in the case of the Imperial pound, &c.

Current Strength.

AMPÈRE. An unvarying current which, passed through a solution of silver nitrate in water, deposits silver at the rate of 0·001118 gramme per second (equiv. to 0·00328 gramme Cu) is taken as an *ampère*.

Electro-motive Force.

VOLT. The standard of electrical pressure (electromotive force), the *volt*, is the pressure which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampère. Clark's cell (zinc, paste of zinc sulphate, paste of mercurous sulphate, mercury) is taken as having a pressure or electromotive force of 1·434 volts. $\textbf{Ampère} = \frac{\textbf{volt}}{\textbf{ohm}}$.

In addition to the foregoing are the colomb and the farad.

Colomb.—When the current strength is one ampère the unit of quantity, which is called a *colomb*, passes in one second. Quantity.

Farad.—The unit of capacity, or *farad*, is that of a condenser upon which one colomb produces a potential of one volt. Capacity.

HEAT MEASUREMENTS.

Calorie. The unit chosen for measurements of heat is the hundredth part of the heat required to raise the temperature of 1 gramme of water from 0° to 100° C. The mechanical equivalent of a calorie is 43280 gm. cm.

E. H. WALDO.

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS.

(Contributed by Mr. W. Dawson.)

Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.
1·000	15·432	·960	14·815	·920	14·197	·880	13·580	·840	12·963
·999	15·416	·959	14·799	·919	14·182	·879	13·565	·839	12·947
·998	15·401	·958	14·784	·918	14·166	·878	13·549	·838	12·932
·997	15·386	·957	14·768	·917	14·151	·877	13·534	·837	12·916
·996	15·370	·956	14·753	·916	14·136	·876	13·518	·836	12·901
·995	15·355	·955	14·737	·915	14·120	·875	13·503	·835	12·886
·994	15·339	·954	14·722	·914	14·105	·874	13·487	·834	12·870
·993	15·324	·953	14·707	·913	14·089	·873	13·472	·833	12·855
·992	15·308	·952	14·691	·912	14·074	·872	13·457	·832	12·839
·991	15·293	·951	14·676	·911	14·058	·871	13·441	·831	12·824
·990	15·278	·950	14·660	·910	14·043	·870	13·426	·830	12·808
·989	15·262	·949	14·645	·909	14·028	·869	13·410	·829	12·793
·988	15·247	·948	14·629	·908	14·012	·868	13·395	·828	12·778
·987	15·231	·947	14·614	·907	13·997	·867	13·379	·827	12·762
·986	15·216	·946	14·599	·906	13·981	·866	13·364	·826	12·747
·985	15·200	·945	14·583	·905	13·966	·865	13·349	·825	12·731
·984	15·185	·944	14·568	·904	13·950	·864	13·333	·824	12·716
·983	15·169	·943	14·552	·903	13·935	·863	13·318	·823	12·700
·982	15·154	·942	14·537	·902	13·920	·862	13·302	·822	12·685
·981	15·138	·941	14·521	·901	13·904	·861	13·287	·821	12·670
·980	15·123	·940	14·506	·900	13·889	·860	13·271	·820	12·654
·979	15·108	·939	14·491	·899	13·873	·859	13·256	·819	12·639
·978	15·092	·938	14·475	·898	13·858	·858	13·241	·818	12·623
·977	15·077	·937	14·460	·897	13·842	·857	13·225	·817	12·608
·976	15·061	·936	14·444	·896	13·827	·856	13·210	·816	12·592
·975	15·046	·935	14·429	·895	13·812	·855	13·194	·815	12·577
·974	15·031	·934	14·413	·894	13·796	·854	13·179	·814	12·562
·973	15·015	·933	14·398	·893	13·781	·853	13·163	·813	12·546
·972	15·000	·932	14·383	·892	13·765	·852	13·148	·812	12·531
·971	14·984	·931	14·367	·891	13·750	·851	13·133	·811	12·515
·970	14·969	·930	14·352	·890	13·734	·850	13·117	·810	12·500
·969	14·954	·929	14·336	·889	13·719	·849	13·102	·809	12·484
·968	14·938	·928	14·321	·888	13·704	·848	13·086	·808	12·469
·967	14·923	·927	14·305	·887	13·688	·847	13·071	·807	12·453
·966	14·907	·926	14·290	·886	13·673	·846	13·055	·806	12·438
·965	14·892	·925	14·275	·885	13·657	·845	13·040	·805	12·423
·964	14·876	·924	14·259	·884	13·642	·844	13·025	·804	12·407
·963	14·861	·923	14·244	·883	13·626	·843	13·009	·803	12·391
·962	14·845	·922	14·228	·882	13·611	·842	12·994	·802	12·376
·961	14·830	·921	14·213	·881	13·595	·841	12·978	·801	12·361

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS—*continued.*

Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.
·800	12·346	·760	11·728	·720	11·111	·680	10·494	·640	9·876
·799	12·330	·759	11·712	·719	11·096	·679	10·478	·639	9·861
·798	12·315	·758	11·697	·718	11·080	·678	10·463	·638	9·846
·797	12·299	·757	11·682	·717	11·065	·677	10·447	·637	9·830
·796	12·284	·756	11·666	·716	11·049	·676	10·432	·636	9·815
·795	12·268	·755	11·651	·715	11·034	·675	10·417	·635	9·799
·794	12·253	·754	11·636	·714	11·018	·674	10·401	·634	9·784
·793	12·237	·753	11·620	·713	11·003	·673	10·386	·633	9·768
·792	12·222	·752	11·605	·712	10·987	·672	10·370	·632	9·753
·791	12·207	·751	11·589	·711	10·972	·671	10·355	·631	9·737
·790	12·191	·750	11·574	·710	10·957	·670	10·339	·630	9·722
·789	12·176	·749	11·559	·709	10·941	·669	10·324	·629	9·707
·788	12·160	·748	11·543	·708	10·926	·668	10·308	·628	9·691
·787	12·145	·747	11·528	·707	10·910	·667	10·293	·627	9·676
·786	12·129	·746	11·512	·706	10·895	·666	10·278	·626	9·660
·785	12·114	·745	11·496	·705	10·879	·665	10·262	·625	9·645
·784	12·099	·744	11·481	·704	10·864	·664	10·247	·624	9·629
·783	12·083	·743	11·466	·703	10·849	·663	10·231	·623	9·614
·782	12·068	·742	11·450	·702	10·833	·662	10·216	·622	9·599
·781	12·052	·741	11·435	·701	10·818	·661	10·200	·621	9·583
·780	12·037	·740	11·419	·700	10·802	·660	10·185	·620	9·568
·779	12·021	·739	11·404	·699	10·787	·659	10·170	·619	9·552
·778	12·006	·738	11·389	·698	10·771	·658	10·154	·618	9·537
·777	11·991	·737	11·373	·697	10·756	·657	10·139	·617	9·521
·776	11·975	·736	11·358	·696	10·741	·656	10·123	·616	9·506
·775	11·960	·735	11·342	·695	10·725	·655	10·108	·615	9·490
·774	11·944	·734	11·327	·694	10·710	·654	10·092	·614	9·475
·773	11·929	·733	11·312	·693	10·694	·653	10·078	·613	9·460
·772	11·913	·732	11·296	·692	10·679	·652	10·061	·612	9·444
·771	11·898	·731	11·280	·691	10·663	·651	10·046	·611	9·429
·770	11·883	·730	11·265	·690	10·648	·650	10·030	·610	9·413
·769	11·867	·729	11·250	·689	10·633	·649	10·015	·609	9·398
·768	11·852	·728	11·234	·688	10·617	·648	10·000	·608	9·383
·767	11·836	·727	11·219	·687	10·602	·647	9·984	·607	9·367
·766	11·821	·726	11·203	·686	10·586	·646	9·969	·606	9·352
·765	11·805	·725	11·188	·685	10·571	·645	9·954	·605	9·336
·764	11·790	·724	11·172	·684	10·555	·644	9·938	·604	9·321
·763	11·774	·723	11·157	·683	10·540	·643	9·923	·603	9·305
·762	11·759	·722	11·142	·682	10·525	·642	9·907	·602	9·290
·761	11·744	·721	11·126	·681	10·509	·641	9·892	·601	9·275

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS—*continued.*

Grms.	Grains.	Grms.	Grains.	Grms.	Grains	Grms.	Grains.	Grms.	Grains.
·600	9·259	·560	8·642	·520	8·025	·480	7·407	·440	6·790
·599	9·244	·559	8·636	·519	8·009	·479	7·392	·439	6·775
·598	9·228	·558	8·621	·518	7·994	·478	7·376	·438	6·759
·597	9·213	·557	8·606	·517	7·978	·477	7·361	·437	6·744
·596	9·197	·556	8·590	·516	7·963	·476	7·346	·436	6·728
·595	9·182	·555	8·574	·515	7·947	·475	7·330	·435	6·713
·594	9·167	·554	8·559	·514	7·932	·474	7·315	·434	6·698
·593	9·151	·553	8·543	·513	7·917	·473	7·300	·433	6·682
·592	9·136	·552	8·518	·512	7·901	·472	7·284	·432	6·667
·591	9·120	·551	8·503	·511	7·886	·471	7·268	·431	6·651
·590	9·105	·550	8·488	·510	7·870	·470	7·253	·430	6·636
·589	9·089	·549	8·472	·509	7·855	·469	7·238	·429	6·620
·588	9·074	·548	8·457	·508	7·839	·468	7·222	·428	6·605
·587	9·058	·547	8·441	·507	7·824	·467	7·207	·427	6·589
·586	9·043	·546	8·426	·506	7·808	·466	7·191	·426	6·574
·585	9·028	·545	8·410	·505	7·793	·465	7·176	·425	6·559
·584	9·012	·544	8·395	·504	7·778	·464	7·160	·424	6·543
·583	8·997	·543	8·379	·503	7·762	·463	7·145	·423	6·528
·582	8·981	·542	8·364	·502	7·746	·462	7·130	·422	6·512
·581	8·965	·541	8·349	·501	7·731	·461	7·114	·421	6·497
·580	8·950	·540	8·333	·500	7·716	·460	7·099	·420	6·481
·579	8·935	·539	8·318	·499	7·700	·459	7·083	·419	6·466
·578	8·920	·538	8·302	·498	7·685	·458	7·068	·418	6·450
·577	8·904	·537	8·287	·497	7·670	·457	7·052	·417	6·435
·576	8·889	·536	8·271	·496	7·654	·456	7·037	·416	6·420
·575	8·873	·535	8·256	·495	7·639	·455	7·021	·415	6·404
·574	8·858	·534	8·241	·494	7·623	·454	7·006	·414	6·389
·573	8·842	·533	8·225	·493	7·608	·453	6·991	·413	6·373
·572	8·827	·532	8·210	·492	7·592	·452	6·975	·412	6·358
·571	8·812	·531	8·194	·491	7·577	·451	6·960	·411	6·342
·570	8·796	·530	8·179	·490	7·561	·450	6·944	·410	6·327
·569	8·781	·529	8·163	·489	7·546	·449	6·929	·409	6·312
·568	8·765	·528	8·148	·488	7·531	·448	6·913	·408	6·296
·567	8·750	·527	8·133	·487	7·515	·447	6·898	·407	6·281
·566	8·734	·526	8·117	·486	7·500	·446	6·883	·406	6·265
·565	8·719	·525	8·102	·485	7·484	·445	6·867	·405	6·250
·564	8·704	·524	8·086	·484	7·469	·444	6·852	·404	6·234
·563	8·688	·523	8·071	·483	7·454	·443	6·836	·403	6·219
·562	8·673	·522	8·055	·482	7·436	·442	6·821	·402	6·204
·561	8·657	·521	8·040	·481	7·423	·441	6·805	·401	6·188

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS—*continued.*

Grms.	Grains.	Grms	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.
·400	6·173	·360	5·555	·320	4·938	·280	4·321	·240	3·704
·399	6·157	·359	5·540	·319	4·922	·279	4·305	·239	3·688
·398	6·142	·358	5·525	·318	4·907	·278	4·290	·238	3·673
·397	6·126	·357	5·509	·317	4·892	·277	4·275	·237	3·657
·396	6·111	·356	5·494	·316	4·876	·276	4·259	·236	3·642
·395	6·096	·355	5·478	·315	4·861	·275	4·244	·235	3·626
·394	6·080	·354	5·462	·314	4·846	·274	4·228	·234	3·611
·393	6·065	·353	5·447	·313	4·830	·273	4·213	·233	3·596
·392	6·049	·352	5·432	·312	4·815	·272	4·197	·232	3·580
·391	6·034	·351	5·417	·311	4·800	·271	4·182	·231	3·565
·390	6·018	·350	5·401	·310	4·784	·270	4·167	·230	3·549
·389	6·003	·349	5·386	·309	4·768	·269	4·151	·229	3·534
·388	5·987	·348	5·370	·308	4·753	·268	4·136	·228	3·518
·387	5·972	·347	5·355	·307	4·738	·267	4·120	·227	3·503
·386	5·957	·346	5·340	·306	4·722	·266	4·105	·226	3·488
·385	5·941	·345	5·324	·305	4·707	·265	4·089	·225	3·472
·384	5·926	·344	5·309	·304	4·691	·264	4·074	·224	3·457
·383	5·910	·343	5·293	·303	4·676	·263	4·059	·223	3·441
·382	5·895	·342	5·278	·302	4·660	·262	4·043	·222	3·426
·381	5·879	·341	5·262	·301	4·645	·261	4·028	·221	3·410
·380	5·864	·340	5·247	·300	4·630	·260	4·012	·220	3·395
·379	5·849	·339	5·231	·299	4·614	·259	3·997	·219	3·380
·378	5·833	·338	5·216	·298	4·599	·258	3·981	·218	3·364
·377	5·818	·337	5·200	·297	4·583	·257	3·966	·217	3·349
·376	5·802	·336	5·185	·296	4·568	·256	3·950	·216	3·333
·375	5·787	·335	5·170	·295	4·552	·255	3·935	·215	3·318
·374	5·771	·334	5·154	·294	4·537	·254	3·920	·214	3·302
·373	5·756	·333	5·139	·293	4·521	·253	3·904	·213	3·287
·372	5·741	·332	5·123	·292	4·506	·252	3·889	·212	3·271
·371	5·725	·331	5·108	·291	4·491	·251	3·873	·211	3·256
·370	5·710	·330	5·092	·290	4·475	·250	3·858	·210	3·241
·369	5·694	·329	5·077	·289	4·460	·249	3·842	·209	3·225
·368	5·679	·328	5·062	·288	4·444	·248	3·827	·208	3·210
·367	5·663	·327	5·016	·287	4·429	·247	3·812	·207	3·194
·366	5·648	·326	5·031	·286	4·413	·246	3·796	·206	3·179
·365	5·633	·325	5·015	·285	4·398	·245	3·781	·205	3·163
·364	5·617	·324	5·000	·284	4·383	·244	3·765	·204	3·148
·363	5·602	·323	4·984	·283	4·367	·243	3·750	·203	3·133
·362	5·586	·322	4·969	·282	4·352	·242	3·734	·202	3·117
·361	5·571	·321	4·953	·281	4·336	·241	3·719	·201	3·102

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS—*continued.*

Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.	Grms.	Grains.
·200	3·086	·160	2·470	·120	1·852	·080	1·234	·040	0·617
·199	3·071	·159	2·454	·119	1·836	·079	1·219	·039	0·602
·198	3·055	·158	2·438	·118	1·821	·078	1·204	·038	0·586
·197	3·040	·157	2·423	·117	1·805	·077	1·188	·037	0·571
·196	3·025	·156	2·407	·116	1·790	·076	1·173	·036	0·555
·195	3·009	·155	2·392	·115	1·775	·075	1·157	·035	0·540
·194	2·994	·154	2·376	·114	1·759	·074	1·142	·034	0·525
·193	2·978	·153	2·361	·113	1·744	·073	1·126	·033	0·509
·192	2·963	·152	2·346	·112	1·728	·072	1·111	·032	0·494
·191	2·947	·151	2·330	·111	1·713	·071	1·096	·031	0·478
·190	2·932	·150	2·315	·110	1·697	·070	1·080	·030	0·463
·189	2·917	·149	2·299	·109	1·682	·069	1·065	·029	0·447
·188	2·901	·148	2·284	·108	1·667	·068	1·049	·028	0·432
·187	2·886	·147	2·268	·107	1·651	·067	1·034	·027	0·417
·186	2·870	·146	2·253	·106	1·636	·066	1·018	·026	0·401
·185	2·855	·145	2·238	·105	1·620	·065	1·003	·025	0·386
·184	2·839	·144	2·222	·104	1·605	·064	0·987	·024	0·370
·183	2·824	·143	2·207	·103	1·589	·063	0·972	·023	0·355
·182	2·809	·142	2·191	·102	1·574	·062	0·957	·022	0·339
·181	2·793	·141	2·175	·101	1·559	·061	0·941	·021	0·324
·180	2·778	·140	2·160	·100	1·543	·060	0·926	·020	0·309
·179	2·762	·139	2·145	·099	1·528	·059	0·910	·019	0·293
·178	2·747	·138	2·130	·098	1·512	·058	0·895	·018	0·278
·177	2·731	·137	2·114	·097	1·497	·057	0·880	·017	0·262
·176	2·716	·136	2·099	·096	1·481	·056	0·862	·016	0·247
·175	2·701	·135	2·083	·095	1·466	·055	0·849	·015	0·231
·174	2·685	·134	2·068	·094	1·451	·054	0·833	·014	0·216
·173	2·670	·133	2·052	·093	1·435	·053	0·818	·013	0·200
·172	2·654	·132	2·037	·092	1·420	·052	0·802	·012	0·185
·171	2·639	·131	2·021	·091	1·404	·051	0·787	·011	0·170
·170	2·623	·130	2·006	·090	1·389	·050	0·772	·010	0·154
·169	2·608	·129	1·991	·089	1·373	·049	0·756	·009	0·139
·168	2·592	·128	1·975	·088	1·358	·048	0·741	·008	0·123
·167	2·577	·127	1·960	·087	1·342	·047	0·725	·007	0·108
·166	2·562	·126	1·944	·086	1·327	·046	0·710	·006	0·092
·165	2·546	·125	1·929	·085	1·312	·045	0·694	·005	0·077
·164	2·531	·124	1·913	·084	1·296	·044	0·679	·004	0·062
·163	2·515	·123	1·898	·083	1·281	·043	0·663	·003	0·046
·162	2·500	·122	1·883	·082	1·265	·042	0·648	·002	0·031
·161	2·484	·121	1·867	·081	1·250	·041	0·633	·001	0·015

TABLE FOR THE CONVERSION OF GRAMS INTO GRAINS—*continued.*

Grams.	Grains.	Grams.	Grains.	Grams.	Grains.
2	30·865	45	694·456	140	2160·523
3	46·297	50	771·617	150	2314·852
4	61·729	55	848·779	160	2469·176
5	77·162	60	925·941	170	2623·499
6	92·594	65	1003·103	180	2777·823
7	108·026	70	1080·264	190	2932·146
8	123·459	75	1157·426	200	3086·470
9	138·891	80	1234·588	300	4629·705
10	154·323	85	1311·750	400	6172·940
15	231·485	90	1388·911	500	7716·174
20	308·647	95	1466·073	600	9259·409
25	385·809	100	1543·235	700	10802·644
30	462·970	110	1697·558	800	12345·879
35	540·132	120	1851·882	900	13889·114
40	617·294	130	2006·205	1000	15432·349

TABLE FOR THE CONVERSION OF GRAINS INTO GRAMS.

Grns.	Grams.	Grns.	Grams.	Grns.	Grams.	Grns.	Grams.
1	·0648	6	·3888	11	·7128	16	1·0368
2	·1296	7	·4536	12	·7776	17	1·1016
3	·1944	8	·5184	13	·8424	18	1·1664
4	·2592	9	·5832	14	·9072	19	1·2312
5	·3240	10	·6480	15	·9720	20	1·2960

TABLE FOR THE CONVERSION, &c.—*continued.*

Grains.	Grams.	Grains.	Grams.	Grains.	Grams.
21	1·3608	51	3·3047	81	5·2487
22	1·4256	52	3·3695	82	5·3135
23	1·4904	53	3·4343	83	5·3783
24	1·5552	54	3·4991	84	5·4431
25	1·6200	55	3·5639	85	5·5079
26	1·6848	56	3·6287	86	5·5727
27	1·7496	57	3·6935	87	5·6375
28	1·8144	58	3·7583	88	5·7023
29	1·8792	59	3·8231	89	5·7671
30	1·9440	60	3·8879	90	5·8319
31	2·0088	61	3·9527	91	5·8967
32	2·0736	62	4·0175	92	5·9615
33	2·1384	63	4·0823	93	6·0263
34	2·2032	64	4·1471	94	6·0911
35	2·2680	65	4·2119	95	6·1559
36	2·3328	66	4·2767	96	6·2207
37	2·3976	67	4·3415	97	6·2855
38	2·4624	68	4·4063	98	6·3503
39	2·5272	69	4·4711	99	6·4151
40	2·5920	70	4·5359	100	6·4799
41	2·6568	71	4·6007	101	6·5447
42	2·7216	72	4·6655	102	6·6095
43	2·7863	73	4·7303	103	6·6743
44	2·8511	74	4·7951	104	6·7391
45	2·9159	75	4·8599	105	6·8039
46	2·9807	76	4·9247	106	6·8687
47	3·0455	77	4·9895	107	6·9335
48	3·1103	78	5·0543	108	6·9983
49	3·1751	79	5·1191	109	7·0631
50	3·2399	80	5·1839	110	7·1279

Table for the Conversion, &c.—*continued.*

Grains.	Grams.	Grains.	Grams.	Grains.	Grams.
111	7·1927	141	9·1366	171	11·0806
112	7·2575	142	9·2104	172	11·1454
113	7·3223	143	9·2662	173	11·2102
114	7·3871	144	9·3310	174	11·2750
115	7·4519	145	9·3958	175	11·3398
116	7·5177	146	9·4606	176	11·4046
117	7·5815	147	9·5254	177	11·4694
118	7·6463	148	9·5902	178	11·5342
119	7·7111	149	9·6550	179	11·5990
120	7·7759	150	9·7198	180	11·6638
121	7·8407	151	9·7846	181	11·7286
122	7·9055	152	9·8494	182	11·7934
123	7·9703	153	9·9142	183	11·8582
124	8·0351	154	9·9790	184	11·9230
125	8·0999	155	10·0438	185	11·9878
126	8·1647	156	10·1086	186	12·0526
127	8·2295	157	10·1734	187	12·1174
128	8·2943	158	10·2382	188	12·1822
129	8·3591	159	10·3030	189	12·2470
130	8·4239	160	10·3678	190	12·3118
131	8·4887	161	10·4326	200	12·9598
132	8·5536	162	10·4974	250	16·1997
133	8·6183	163	10·5622	300	19·4397
134	8·6831	164	10·6270	400	25·9196
135	8·7479	165	10·6918	500	32·3995
136	8·8127	166	10·7566	600	38·8794
137	8·8775	167	10·8214	700	45·3593
138	8·9422	168	10·8862	800	51·8392
139	9·0070	169	10·9510	900	58·3190
140	9·0718	170	11·0158	1000	64·7989

TABLE SHOWING EQUIVALENT RATES PER LB., CWT., AND TON.

Per lb.	Per cwt.		Per ton.			Per lb.	Per cwt.		Per ton.		
d.	s.	d.	£	s.	d.	d.	s.	d.	£	s.	d.
¼	2	4	2	6	8	6¼	58	4	58	6	8
½	4	8	4	13	4	6½	60	8	60	13	4
¾	7	0	7	0	0	6¾	63	0	63	0	0
1	9	4	9	6	8	7	65	4	65	6	8
1¼	11	8	11	13	4	7¼	67	8	67	13	4
1½	14	0	14	0	0	7½	70	0	70	0	0
1¾	16	4	16	6	8	7¾	72	4	72	6	8
2	18	8	18	13	4	8	74	8	74	13	4
2¼	21	0	21	0	0	8¼	77	0	77	0	0
2½	23	4	23	6	8	8½	79	4	79	6	8
2¾	25	8	25	13	4	8¾	81	8	81	13	4
3	28	0	28	0	0	9	84	0	84	0	0
3¼	30	4	30	6	8	9¼	86	4	86	6	8
3½	32	8	32	13	4	9½	88	8	88	13	4
3¾	35	0	35	0	0	9¾	91	0	91	0	0
4	37	4	37	6	8	10	93	4	93	6	8
4¼	39	8	39	13	4	10¼	95	8	95	13	4
4½	42	0	42	0	0	10½	98	0	98	0	0
4¾	44	4	44	6	8	10¾	100	4	100	6	8
5	46	8	46	13	4	11	102	8	102	13	4
5¼	49	0	49	0	0	11¼	105	0	105	0	0
5½	51	4	51	6	8	11½	107	4	107	6	8
5¾	53	8	53	13	4	11¾	109	8	109	13	4
6	56	0	56	0	0	12	112	0	112	0	0

DECIMAL EQUIVALENTS OF PENCE AND SHILLINGS.

Pence.	Shillings.	Pence.	Shillings.	Pence.	Shillings.
½ ..	= ·04166	4½ ..	= ·3750	8½ ..	= ·70832
1 ..	= ·08333	5 ..	= ·41666	9 ..	= ·75
1½ ..	= ·125	5½ ..	= ·45833	9½ ..	= ·79166
2 ..	= ·16666	6 ..	= ·5	10 ..	= ·83333
2½ ..	= ·20832	6½ ..	= ·54166	10½ ..	= ·8750
3 ..	= ·25	7 ..	= ·58333	11 ..	= ·91666
3½ ..	= ·29166	7½ ..	= ·6250	11½ ..	= ·95833
4 ..	= ·33333	8 ..	= ·66666	12 ..	= 1·0000

DECIMAL EQUIVALENTS OF LBS., QRS., AND CWTS.

qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.	qrs.	lbs.	cwts.
0	0½	=·0045	1	0	=·25	2	0	=·5	3	0	=·75
0	1	·0089	1	1	·2589	2	1	·5089	3	1	·7589
0	2	·0179	1	2	·2679	2	2	·5179	3	2	·7679
0	3	·0268	1	3	·2768	2	3	·5268	3	3	·7768
0	4	·0357	1	4	·2857	2	4	·5357	3	4	·7857
0	5	·0446	1	5	·2946	2	5	·5446	3	5	·7946
0	6	·0536	1	6	·3036	2	6	·5536	3	6	·8036
0	7	·0625	1	7	·3125	2	7	·5625	3	7	·8125
0	8	·0714	1	8	·3214	2	8	·5714	3	8	·8214
0	9	·0803	1	9	·3303	2	9	·5803	3	9	·8303
0	10	·0893	1	10	·3393	2	10	·5893	3	10	·8393
0	11	·0982	1	11	·3482	2	11	·5982	3	11	·8482
0	12	·1071	1	12	·3571	2	12	·6071	3	12	·8571
0	13	·1161	1	13	·3661	2	13	·6161	3	13	·8661
0	14	·125	1	14	·375	2	14	·625	3	14	·875
0	15	·1339	1	15	·3839	2	15	·6339	3	15	·8839
0	16	·1429	1	16	·3929	2	16	·6429	3	16	·8929
0	17	·1518	1	17	·4018	2	17	·6518	3	17	·9018
0	18	·1607	1	18	·4107	2	18	·6607	3	18	·9107
0	19	·1696	1	19	·4196	2	19	·6696	3	19	·9196
0	20	·1786	1	20	·4286	2	20	·6786	3	20	·9286
0	21	·1875	1	21	·4375	2	21	·6875	3	21	·9375
0	22	·1964	1	22	·4464	2	22	·6964	3	22	·9464
0	23	·2054	1	23	·4554	2	23	·7054	3	23	·9554
0	24	·2143	1	24	·4643	2	24	·7143	3	24	·9643
0	25	·2232	1	25	·4732	2	25	·7232	3	25	·9732
0	26	·2322	1	26	·4822	2	26	·7322	3	26	·9822
0	27	·2411	1	27	·4911	2	27	·7411	3	27	·9911

DECIMAL EQUIVALENTS OF POUNDS AND OUNCES.

ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.	ozs.	lbs.
¼	·015625	3	·1875	6½	·40625	10	·625	13½	·84375
½	·03125	3½	·21875	7	·4375	10½	·65625	14	·875
¾	·046875	4	·25	7½	·46875	11	·6875	14½	·90625
1	·0625	4½	·28125	8	·5	11½	·71875	15	·9375
1½	·09375	5	·3125	8½	·53125	12	·75	15½	·96875
2	·125	5½	·34375	9	·5625	12½	·78125	16	1·0
2½	·15625	6	·375	9½	·59375	13	·8125		

Table for the Conversion of Percentage into Cwts. and Lbs. per Ton, and into Lbs. per Cwt.

Per Cent.	Per Ton.		Per Cwt.	Per Cent.	Per Ton.		Per Cwt.
	Cwts.	Lbs.	Lbs.		Cwts.	Lbs.	Lbs.
1	—	22·4	1·12	26	5	22·4	29·12
2	—	44·8	2·24	27	5	44·8	30·24
3	—	67·2	3·36	28	5	67·2	31·36
4	—	89·6	4·48	29	5	89·6	32·48
5	1	0	5·60	30	6	0	33·60
6	1	22·4	6·72	31	6	22·4	34·72
7	1	44·8	7·84	32	6	44·8	35·84
8	1	67·2	8·96	33	6	67·2	36·96
9	1	89·6	10·08	34	6	89·6	38·08
10	2	0	11·20	35	7	0	39·20
11	2	22·4	12·32	36	7	22·4	40·32
12	2	44·8	13·44	37	7	44·8	41·44
13	2	67·2	14·56	38	7	67·2	42·56
14	2	89·6	15·68	39	7	89·6	43·68
15	3	0	16·8	40	8	0	44·80
16	3	22·4	17·92	41	8	22·4	45·92
17	3	44·8	19·04	42	8	44·8	47·04
18	3	67·2	20·16	43	8	67·2	48·16
19	3	89·6	21·28	44	8	89·6	49·28
20	4	0	22·40	45	9	0	50·40
21	4	22·4	23·52	46	9	22·4	51·52
22	4	44·8	24·64	47	9	44·8	52·64
23	4	67·2	25·76	48	9	67·2	53·76
24	4	89·6	26·88	49	9	89·6	54·88
25	5	0	28·00	50	10	0	56·00

TABLE FOR THE CONVERSION OF PERCENTAGE INTC CWTS. AND LBS., &C.—*continued.*

Per Cent.	Per Ton.		Per Cwt.	Per Cent.	Per Ton.		Per Cwt.
	Cwts.	Lbs.	Lbs.		Cwts.	Lbs.	Lbs.
51	10	22·4	57·12	76	15	22·4	85·12
52	10	44·8	58·24	77	15	44·8	86·24
53	10	67·2	59·36	78	15	67·2	87·36
54	10	89·6	60·48	79	15	89·6	88·48
55	11	0	61·60	80	16	0	89·60
56	11	22·4	62·72	81	16	22·4	90·72
57	11	44·8	63·84	82	16	44·8	91·84
58	11	67·2	64·96	83	16	67·2	92·96
59	11	89·6	66·08	84	16	89·6	94·08
60	12	0	67·20	85	17	0	95·20
61	12	22·4	68·32	86	17	22·4	96·32
62	12	44·8	69·44	87	17	44·8	97·44
63	12	67·2	70·56	88	17	67·2	98·56
64	12	89·6	71·68	89	17	89·6	99·68
65	13	0	72·80	90	18	0	100·80
66	13	22·4	73·92	91	18	22·4	101·92
67	13	44·8	75·04	92	18	44·8	103·04
68	13	67·2	76·16	93	18	67·2	104·16
69	13	89·6	77·28	94	18	89·6	105·28
70	14	0	78·40	95	19	0	106·40
71	14	22·4	79·52	96	19	22·4	107·52
72	14	44·8	80·64	97	19	44·8	108·64
73	14	67·2	81·76	98	19	67·2	109·76
74	14	89·6	82·88	99	19	89·6	110·88
75	15	0	84·00	100	20	0	112·00

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES. (G.M.J.)

Oz. Av.	Oz. Av.	Grains.	Grammes.
$\frac{1}{1000}$	·0010	·4375	·0283
$\frac{1}{500}$	·0020	·8750	·0567
$\frac{1}{400}$	·0025	1·0938	·0709
$\frac{3}{1000}$	·0030	1 3125	·0851
$\frac{1}{250}$	·0040	1·7500	·1134
$\frac{1}{200}$	·0050	2·1875	·1418
$\frac{3}{500}$	·0060	2·6250	·1701
$\frac{7}{1000}$	·0070	3·0625	·1985
$\frac{3}{400}$	·0075	3·2812	·2126
$\frac{1}{125}$	·0080	3·5000	·2268
$\frac{9}{1000}$	·0090	3·9375	·2552
$\frac{1}{100}$	·0100	4 3750	·2835
$\frac{1}{50}$	·0200	8·7500	·5670
$\frac{1}{40}$	·0250	10·9375	·7087
$\frac{3}{100}$	·0300	13·1250	·8505
$\frac{1}{25}$	·0400	17·5000	1·1340
$\frac{1}{24}$	$\cdot 041\dot{6}$	18·2292	1·1812
$\frac{1}{23}$	·0435	19·0217	1·2326
$\frac{1}{22}$	$\cdot 0\dot{4}\dot{5}4$	$19\cdot 88\dot{6}\dot{3}$	1·2886
$\frac{1}{21}$	·0476	$20\cdot 8\dot{3}33$	1·3500
$\frac{1}{20}$	·0500	21·8750	1·4175
$\frac{1}{19}$	·0526	23·0263	1·4921
$\frac{1}{18}$	$\cdot 0\dot{5}55$	24·3055	1·5750
$\frac{1}{17}$	·0588	25·7353	1·6676

N.B.—This table (which contains every fraction down to one-twenty-fifth) may also be used for the mutual conversion of vulgar and decimal fractions; for example: what is the nearest vulgar fraction to 0·72, and what decimal fraction corresponds to $\frac{13}{18}$? The vulgar fraction will be found in the first column, and is equal to $0\cdot 7\dot{2}$; the decimal fraction will be found in the second column, and is equal to $\frac{18}{25}$. It may also be used for finding which of two vulgar fractions is the greater, as for example $\frac{13}{18}$ and $\frac{8}{11}$, which will be found to be equal to $0\cdot 7\dot{2}$ and $0\cdot\dot{7}\dot{2}$ respectively; $\frac{8}{11}$ being the greater; and the nearest vulgar fraction to the difference between two other vulgar fractions may be found thus: find the two given fractions in the first column, and take the difference of the corresponding decimal fractions, which difference may be sought in the second column, and opposite to it will be found the required vulgar fraction, thus: what is the difference between $\frac{9}{17}$ and $\frac{19}{23}$? By inspection, $\frac{6}{17} = 0\cdot 3529$, and $\frac{19}{23} = 0\cdot 8261$; then $0\cdot 8261 - 0\cdot 3529 = 0\cdot 5092$, which, by inspection, will be found to be nearest to $\frac{1}{2}$, the error in this case being less than one-hundredth, and in no case greater than one-fiftieth.

See note on next page.

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{3}{50}$	·0600	26·2500	1·7010				
$\frac{1}{16}$	·0625	27·3438	1·7718				
$\frac{1}{15}$	$\cdot 06\dot{6}6$	$29\cdot 1\dot{6}66$	1·8900				
$\frac{7}{100}$	·0700	30·6250	1·9845	*Note.*—This table was calculated by the late Mr. G. M. Jones before the latest determinations of equivalence between Imperial and Metric weights and measures (referred to on p. 95, 96) had been published, but the differences are too slight to be of any consequence. Thus the new equivalent for 16 oz. av. is 453·59243 grains, whereas the equivalent in this table is 453·5923 grains. The same remarks apply to the table on pp. 104 et seq.			
$\frac{1}{14}$	·0714	31·2500	2·0250				
$\frac{3}{40}$	·0750	32·8125	2·1262				
$\frac{1}{13}$	·0769	33·6538	2·1807				
$\frac{2}{25}$	·0800	35·0000	2·2680				
$\frac{1}{12}$	$\cdot 08\dot{3}3$	$36\cdot 458\dot{3}$	2·3625				
$\frac{2}{23}$	·0870	38·0435	2·4652				
$\frac{9}{100}$	·0900	39·3750	2·5515				
$\frac{1}{11}$	$\cdot\dot{0}\dot{9}09$	$39\cdot 7\dot{7}\dot{2}7$	2·5772				
$\frac{2}{21}$	·0952	$41\cdot\dot{6}666$	2·7000				
$\frac{1}{10}$	·1000	43·7500	2·8350				
$\frac{2}{19}$	·1053	46·0526	2·9842				
$\frac{1}{9}$	$\cdot\dot{1}111$	$48\cdot 6\dot{1}11$	3·1499				
$\frac{2}{17}$	·1176	51·4706	3·3352				
$\frac{3}{25}$	·1200	52·5000	3·4019				
$\frac{1}{8}$	·1250	54·6875	3·5437			2	14·688
$\frac{3}{23}$	·1304	57·0652	3·6978				
$\frac{2}{15}$	$\cdot 1\dot{3}33$	$58\cdot\dot{3}333$	3·7799				
$\frac{3}{22}$	$\cdot 1\dot{3}\dot{6}3$	$59\cdot 65\dot{9}\dot{0}$	3·8658				
$\frac{1}{7}$	·1429	62·5000	4·0499				
$\frac{3}{20}$	·1500	65·6250	4·2524				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight. ℥	ʒ	℈	grains.
2/13	·1538	67·3077	4·3615				
3/19	·1579	69·0789	4·4762				
4/25	·1600	70·0000	4·5359				
1/6	·1̇666	72·9166̇	4·7249				
4/23	·1739	76·0870	4·9304				
3/17	·1765	77·2059	5·0029				
2/11	·1̇81̇8	79·5̇45̇4	5·1545				
3/16	·1875	82·0313	5·3155		1	1	2·031
4/21	·1905	83·3̇333	5·3999				
1/5	·2000	87·5000	5·6699				
5/24	·2083̇	91·1458	5·9062				
4/19	·2105	92·1053	5 9683				
3/14	·2143	93·7500	6·0749				
5/23	·2174	95·1087	6·1629				
2/9	·2̇222	97·2̇222	6·2999				
5/22	·22̇72̇	99·43̇18̇	6·4431				
3/13	·2308	100·9615	6·5422				
4/17	·2353	102·9412	6·6705				
5/21	·2381	104·1̇666	6·7499				
6/25	·2400	105·0000	6·8039				
1/4	·2500	109·3750	7·0874		1	2	9·375
6/23	·2609	114·1304	7·3955				
5/19	·2632	115·1316	7·4604				
4/15	·26̇66	116·6̇666	7·5599				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight. ℥	ʒ	℈	grains.
$\frac{3}{11}$	·2̇7̇27	119·31̇8̇1	7·7317				
$\frac{5}{18}$	·27̇77	121·527̇7	7·8749				
$\frac{7}{25}$	·2800	122·5000	7·9379				
$\frac{2}{7}$	·2857	125·0000	8·0999				
$\frac{7}{24}$	·2916̇	127·6042	8·2686				
$\frac{5}{17}$	·2941	128·6765	8·3381				
$\frac{3}{10}$	·3000	131·2500	8·5049				
$\frac{7}{23}$	·3043	133·1522	8·6281				
$\frac{4}{13}$	·3077	134·6154	8·7229				
$\frac{5}{16}$	·3125	136·7188	8·8592		2	0	16·719
$\frac{6}{19}$	·3158	138·1579	8·9525				
$\frac{7}{22}$	·31̇8̇1	139·204̇5̇	9·0203				
$\frac{8}{25}$	·3200	140·0000	9·0719				
$\frac{1}{3}$	·3̇333	145·83̇33	9·4498				
$\frac{8}{23}$	·3478	152·1739	9·8607				
$\frac{7}{20}$	·3500	153·1250	9·9223				
$\frac{6}{17}$	·3529	154·4118	10·0057				
$\frac{5}{14}$	·3571	156·2500	10·1248				
$\frac{9}{25}$	·3600	157·5000	10·2058				
$\frac{4}{11}$	·3̇6̇36	159·0̇9̇09	10·3089				
$\frac{7}{19}$	·3684	161·1842	10·4446				
$\frac{3}{8}$	·3750	164·0625	10·6311		2	2	4·063
$\frac{8}{21}$	·3810	166·6̇666	10·7998				
$\frac{5}{13}$	·3846	168·2692	10·9037				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight, ℥	ʒ	℈	grains.
$\frac{7}{18}$	$\cdot 3\dot{8}88$	$170\cdot 13\dot{8}8$	11·0248				
$\frac{9}{23}$	·3913	171·1957	11·0933				
$\frac{2}{5}$	·4000	175·0000	11·3398				
$\frac{9}{22}$	$\cdot 4\dot{0}\dot{9}0$	178·9773	11·5975				
$\frac{7}{17}$	·4118	180·1471	11·6733				
$\frac{5}{12}$	$\cdot 41\dot{6}6$	$182\cdot 291\dot{6}$	11·8123				
$\frac{8}{19}$	·4211	184·2105	11·9366				
$\frac{3}{7}$	·4286	187·5000	12·1498				
$\frac{10}{23}$	·4348	190·2174	12·3259				
$\frac{7}{16}$	·4375	191·4063	12·4029		3	0	11·406
$\frac{11}{25}$	·4400	192·5000	12·4738				
$\frac{4}{9}$	$\cdot\dot{4}444$	$194\cdot\dot{4}444$	12·5998				
$\frac{9}{20}$	·4500	196·8750	12·7573				
$\frac{5}{11}$	$\cdot\dot{4}\dot{5}45$	$198\cdot 8\dot{6}\dot{3}6$	12·8862				
$\frac{11}{24}$	$\cdot 485\dot{3}$	200·5208	12·9935				
$\frac{6}{13}$	·4615	201·9231	13·0844				
$\frac{7}{15}$	$\cdot 4\dot{6}66$	$204\cdot 1\dot{6}66$	13·2298				
$\frac{8}{17}$	·4706	205·8824	13·3410				
$\frac{9}{19}$	·4737	207·2368	13·4287				
$\frac{10}{21}$	·4762	$208\cdot\dot{3}333$	13·4998				
$\frac{11}{23}$	·4783	209·2391	13·5585				
$\frac{12}{25}$	·4800	210·0000	13·6078				
$\frac{1}{2}$	·5000	218·7500	14·1748		3	1	18·750
$\frac{13}{25}$	·5200	227·5000	14·7418				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{12}{23}$	·5217	228·2609	14·7911				
$\frac{11}{21}$	·5238	$229\cdot1\dot{6}66$	14·8498				
$\frac{10}{19}$	·5263	230·2632	14·9208				
$\frac{9}{17}$	·5294	231·6176	15·0086				
$\frac{8}{15}$	$\cdot5\dot{3}00$	$233\cdot\dot{3}333$	15·1198				
$\frac{7}{13}$	·5385	235·5769	15·2651				
$\frac{13}{24}$	$\cdot541\dot{6}$	236·9792	15·3560				
$\frac{6}{11}$	$\cdot\dot{5}\dot{4}54$	$238\cdot\dot{6}\dot{3}63$	15·4634				
$\frac{11}{20}$	·5500	240·6250	15·5922				
$\frac{5}{9}$	$\cdot\dot{5}555$	$243\cdot0\dot{5}55$	15·7497				
$\frac{14}{25}$	·5600	245·0000	15·8757				
$\frac{9}{16}$	·5625	246·0938	15·9466		4	0	6·094
$\frac{13}{23}$	·5652	247·2826	16·0237				
$\frac{4}{7}$	·5714	250·0000	16·1997				
$\frac{11}{19}$	·5789	253·2895	16·4129				
$\frac{7}{12}$	$\cdot58\dot{3}3$	$255\cdot208\dot{3}$	16·5372				
$\frac{10}{17}$	·5882	257·3529	16·6762				
$\frac{13}{22}$	$\cdot5\dot{9}\dot{0}9$	$258\cdot52\dot{2}\dot{7}$	16·7520				
$\frac{3}{5}$	·6000	262·5000	17·0097				
$\frac{14}{23}$	·6087	266·3044	17·2562				
$\frac{11}{18}$	$\cdot6\dot{1}11$	$267\cdot36\dot{1}1$	17·3247				
$\frac{8}{13}$	·6154	269·2308	17·4459				
$\frac{13}{21}$	·6190	$270\cdot8\dot{3}33$	17·5497				
$\frac{5}{8}$	·6250	273·4375	17·7185		4	1	13·438

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{12}{19}$	·6316	276·3158	17·9050				
$\frac{7}{11}$	$\cdot\dot{6}\dot{3}63$	278·4001	18·0406				
$\frac{16}{25}$	·6400	280·0000	18·1437				
$\frac{9}{14}$	·6429	281·2500	18·2247				
$\frac{11}{17}$	·6471	283·0882	18·3438				
$\frac{13}{20}$	·6500	284·3750	18·4272				
$\frac{15}{23}$	·6522	285·3261	18·4888				
$\frac{2}{3}$	$\cdot\dot{6}666$	$291\cdot\dot{6}666$	18·8997				
$\frac{17}{25}$	·6800	297·5000	19·2777				
$\frac{15}{22}$	$\cdot 6\dot{8}\dot{1}8$	$298\cdot 29\dot{5}\dot{4}$	19·3292				
$\frac{13}{19}$	·6842	299·3421	19·3971				
$\frac{11}{16}$	·6875	300·7813	19·4903		5	0	0·781
$\frac{9}{13}$	·6923	302·8846	19·6266				
$\frac{16}{23}$	·6957	304·3478	19·7214				
$\frac{7}{10}$	·7000	306·2500	19·8447				
$\frac{12}{17}$	·7059	308·8235	20·0114				
$\frac{17}{24}$	$\cdot 708\dot{3}$	309·8958	20·0809				
$\frac{5}{7}$	·7143	312·5000	20·2497				
$\frac{18}{25}$	·7200	315·0000	20·4117				
$\frac{13}{18}$	$\cdot 7\dot{2}22$	$315\cdot 97\dot{2}2$	20·4747				
$\frac{8}{11}$	$\cdot\dot{7}\dot{2}72$	$318\cdot\dot{1}\dot{8}18$	20·6178				
$\frac{11}{15}$	$\cdot 7\dot{3}33$	$320\cdot 8\dot{3}33$	20·7897				
$\frac{14}{19}$	·7368	322·3684	20·8891				
$\frac{17}{23}$	·7391	323·3696	20·9540				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{3}{4}$	·7500	328·1250	21·2622		5	1	8·125
$\frac{19}{25}$	·7600	332·5000	21·5457				
$\frac{16}{21}$	·7619	$333\cdot\dot{3}333$	21·5996				
$\frac{13}{17}$	·7647	334·5588	21·6791				
$\frac{10}{13}$	·7692	337·5385	21·8073				
$\frac{17}{22}$	$\cdot 7\dot{7}27$	$338\cdot 06\dot{8}\dot{1}$	21·9065				
$\frac{7}{9}$	$\cdot\dot{7}777$	$340\cdot 2\dot{7}77$	22·0496				
$\frac{18}{23}$	·7826	342·3913	22·1866				
$\frac{11}{14}$	·7857	343·7500	22·2747				
$\frac{15}{19}$	·7895	345·3947	22·3812				
$\frac{19}{24}$	$\cdot 791\dot{6}$	346·3542	22·4434				
$\frac{4}{5}$	·8000	350·0000	22·6796				
$\frac{17}{21}$	·8095	$354\cdot 1\dot{6}66$	22·9496				
$\frac{13}{16}$	·8125	355·4688	23·0340		5	2	15·469
$\frac{9}{11}$	$\cdot\dot{8}\dot{1}81$	$357\cdot 9\dot{5}\dot{4}5$	23·1951				
$\frac{14}{17}$	·8235	360·2941	23·3467				
$\frac{19}{23}$	·8261	361·4131	23·4192				
$\frac{5}{6}$	$\cdot 8\dot{3}33$	$364\cdot 58\dot{3}3$	23·6246				
$\frac{21}{25}$	·8400	367·5000	23·8136				
$\frac{16}{19}$	·8421	368·4211	23·8733				
$\frac{11}{13}$	·8462	370·1923	23·9881				
$\frac{17}{20}$	·8500	371·8750	24·0971				
$\frac{6}{7}$	·8571	375·0000	24·2996				
$\frac{19}{22}$	$\cdot 8\dot{6}\dot{3}6$	$377\cdot 84\dot{0}\dot{9}$	24·4837				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{13}{15}$	·8$\dot{6}$66	379·1$\dot{6}$66	24·5696				
$\frac{20}{23}$	·8696	380·4348	24·6518				
$\frac{7}{8}$	·8750	382·8125	24·8058		6	1	2·813
$\frac{22}{25}$	·8800	385·0000	24·9476				
$\frac{15}{17}$	·8824	386·0294	25·0143				
$\frac{8}{9}$	·$\dot{8}$888	388·$\dot{8}$888	25·1996				
$\frac{17}{19}$	·8947	391·4474	25·3654				
$\frac{9}{10}$	·9000	393·7500	25·5146				
$\frac{19}{21}$	·9048	395·8$\dot{3}$33	25·6496				
$\frac{10}{11}$	·$\dot{9}\dot{0}$90	397·$\dot{7}\dot{2}$72	25·7723				
$\frac{21}{23}$	·9130	399·4565	25·8844				
$\frac{11}{12}$	·91$\dot{6}$6	401·041$\dot{6}$	25·9871				
$\frac{23}{25}$	·9200	402·5000	26·0816				
$\frac{12}{13}$	·9231	403·8462	26·1688				
$\frac{13}{14}$	·9286	406·2500	26·3246				
$\frac{14}{15}$	·9$\dot{3}$33	408·$\dot{3}$333	26·4596				
$\frac{15}{16}$	·9375	410·1563	26·5777		6	2	10·156
$\frac{16}{17}$	·9418	411·7647	26·6819				
$\frac{17}{18}$	·9$\dot{4}$44	413·19$\dot{4}$4	26·7746				
$\frac{18}{19}$	·9474	414·4737	26·8575				
$\frac{19}{20}$	·9500	415·6250	26·9321				
$\frac{20}{21}$	·9524	416·$\dot{6}$666	26·9996				
$\frac{21}{22}$	·9$\dot{5}\dot{4}$5	417·61$\dot{3}\dot{6}$	27·0609				
$\frac{22}{23}$	·9565	418·4783	27·1170				

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
$\frac{23}{24}$	·958$\dot{3}$	419·2708	27·1683				
$\frac{24}{25}$	·9600	420·0000	27·2156				
1	1·0	437·5	28·3495	0	7	0	17·5
1¼	1·25	546·875	35·4369	1	1	0	6·875
1½	1·5	656·25	42·5243	1	2	2	16·25
1¾	1·75	765·625	49·6117	1	4	2	5·625
2	2·0	875·0	56·6990	1	6	1	15·0
2¼	2·25	984·375	63·7864	2	0	1	4·375
2½	2·5	1093·75	70·8738	2	2	0	13·75
2¾	2·75	1203·125	77·9612	2	4	0	3·125
3	3·0	1312·5	85·0486	2	5	2	12·5
3¼	3·25	1421·875	92·1359	2	7	2	1·875
3½	3·5	1531·25	99·2233	3	1	1	11·25
3¾	3·75	1640·625	106·3107	3	3	1	0·625
4	4·0	1750·0	113·3981	3	5	0	10·0
4¼	4·25	1859·375	120·4855	3	6	2	19·375
4½	4·5	1968·75	127·5728	4	0	2	8·75
4¾	4·75	2078·125	134·6602	4	2	1	18·125
5	5·0	2187·5	141·7476	4	4	1	7·5
5¼	5·25	2296·875	148·8350	4	6	0	16·875
5½	5·5	2406·25	155·9224	5	0	0	6·25
5¾	5·75	2515·625	163·0097	5	1	2	15·625
6	6·0	2625·0	170·0971	5	3	2	5·0
6¼	6·25	2734·375	177·1845	5	5	1	14·375

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
6½	6 5	2843 75	184·2719	5	7	1	3·75
6¾	6·75	2953·125	191·3593	6	1	0	13·125
7	7·0	3062·5	198·4466	6	3	0	2·5
7¼	7·25	3171·875	205·5340	6	4	2	11·875
7½	7·5	3281·250	212·6214	6	6	2	1·25
7¾	7·75	3390·625	219·7088	7	0	1	10·625
8	8·0	3500·0	226·7962	7	2	1	0·0
8¼	8·25	3609·375	233·8835	7	4	0	9·375
8½	8·5	3718·75	240·9709	7	5	2	18 75
8¾	8·75	3828·125	248·0583	7	7	2	8·125
9	9·0	3937·5	255·1457	8	1	1	17·5
9¼	9·25	4046·875	262·2331	8	3	1	6·875
9½	9·5	4156·250	269·3204	8	5	0	16·25
9¾	9·75	4265·625	276·4078	8	7	0	5·625
10	10·0	4375·0	283·4952	9	0	2	15·0
10¼	10·25	4484·375	290·5826	9	2	2	4·375
10½	10·5	4593·75	297·6700	9	4	1	13·75
10¾	10·75	4703·125	304·7573	9	6	1	3·125
11	11·0	4812·5	311·8447	10	0	0	12·5
11¼	11·25	4921·875	318·9321	10	2	0	1·875
11½	11·5	5031·25	326·0195	10	3	2	11·25
11¾	11·75	5140·625	333·1069	10	5	2	0·625
12	12·0	5250·0	340·1942	10	7	1	10·0
12¼	12·25	5359·375	347·2816	11	1	0	19·375

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
12½	12·5	5468·75	354·3690	11	3	0	8·75
12¾	12·75	5578 125	361·4564	11	4	2	18·125
13	13·0	5687·5	368·5438	11	6	2	7·5
13¼	13·25	5796·875	375·6311	12	0	1	16·875
13½	13·5	5906·25	382·7185	12	2	1	6·25
13¾	13·75	6015·625	389·8059	12	4	0	15·625
14	14·0	6125·0	396·8933	12	6	0	5·0
14¼	14·25	6234·375	403·9807	12	7	2	14·375
14½	14·5	6343·75	411·0680	13	1	2	3·75
14¾	14·75	6453·125	418·1554	13	3	1	13·125
15	15·0	6562·5	425·2428	13	5	1	2·5
15¼	15·25	6671·875	432·3302	13	7	0	11·875
15½	15·5	6781·25	439·4176	14	1	0	1·25
15¾	15·75	6890·625	446·5949	14	2	2	10·625
16	16·0	7000·0	453·5923	14	4	2	0·0
16¼	16·25	7109·375	460·6797	14	6	1	9·375
16½	16·5	7218·75	467·7671	15	0	0	18·75
16¾	16·75	7328·125	474·8545	15	2	0	8·125
17	17·0	7437·5	481·9418	15	3	2	17·5
17¼	17·25	7546·875	489·0292	15	5	2	6·875
17½	17·5	7656·25	496·1166	15	7	1	16·25
17¾	17·75	7765·625	503·2040	16	1	1	5·625
18	18·0	7875·0	510·2914	16	3	0	15·0
18¼	18·25	7984·375	517·3787	16	5	0	4·375

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
18½	18·5	8093·75	524·4661	16	6	2	13·75
18¾	18·75	8203·125	531·5535	17	0	2	3·125
19	19·0	8312·5	538·6409	17	2	1	12·5
19¼	19·25	8421·875	545·7283	17	4	1	1·875
19½	19·5	8531·25	552·8156	17	6	0	11·25
19¾	19·75	8640·625	559·9030	18	0	0	0·625
20	20·0	8750·0	566·9904	18	1	2	10·0
20¼	20·25	8859·375	574·0778	18	3	1	19·375
20½	20·5	8968·75	581·1652	18	5	1	8·75
20¾	20·75	9078·125	588·2525	18	7	0	18·125
21	21·0	9187·5	595·3399	19	1	0	7·5
21¼	21·25	9296·875	602·4273	19	2	2	16·875
21½	21·5	9406·25	609·5147	19	4	2	6·25
21¾	21·75	9515·625	616·6021	19	6	1	15·625
22	22·0	9625·0	623·6894	20	0	1	5·0
22¼	22·25	9734·375	630·7768	20	2	0	14·375
22½	22·5	9843·75	637·8642	20	4	0	3·75
22¾	22·75	9953·125	644·9516	20	5	2	13·125
23	23·0	10062·5	652·0390	20	7	2	2·5
23¼	23·25	10171·875	659·1263	21	1	1	11·875
23½	23·5	10281·25	666·2137	21	3	1	1·25
23¾	23·75	10390·625	673·3011	21	5	0	10·625
24	24·0	10500·0	680·3885	21	7	0	0·0
24¼	24·25	10609·375	687·4759	22	0	2	9·375

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight. ℥	ʒ	℈	grains.
24½	24·5	10718·75	694·5632	22	2	1	18·75
24¾	24·75	10828·125	701·6506	22	4	1	8·125
25	25·0	10937·5	708·7380	22	6	0	17·5
25¼	25·25	11046·875	715·8254	23	0	0	6·875
25½	25·50	11156·25	722·9128	23	1	2	16·25
25¾	25·75	11265·625	730·0001	23	3	2	5·625
26	26·0	11375·0	737·0875	23	5	1	15·0
26¼	26·25	11484·375	744·1749	23	7	1	4·375
26½	26·50	11593·75	751·2623	24	1	0	13·75
26¾	26·75	11703·125	758·3497	24	3	0	3·125
27	27·0	11812·5	765·4370	24	4	2	12·5
27¼	27·25	11921·875	772·5244	24	6	2	1·875
27½	27·5	12031·25	779·6118	25	0	1	11·25
27¾	27·75	12140·625	786·6992	25	2	1	0·625
28	28·0	12250·0	793·7866	25	4	0	10·0
28¼	28·25	12359·375	800·8739	25	5	2	19·375
28½	28·5	12468·75	807·9613	25	7	2	8·75
28¾	28·75	12578·125	815·0487	26	1	1	18·125
29	29·0	12687·5	822·1361	26	3	1	7·5
29¼	29·25	12796·875	829·2235	26	5	0	16·875
29½	29·5	12906·25	836·3108	26	7	0	6·25
29¾	29·75	13015·625	843·3982	27	0	2	15·625
30	30·0	13125·0	850·4856	27	2	2	5·0
30¼	30·25	13234·375	857·5730	27	4	1	14·375

TABLE FOR THE CONVERSION OF AVOIRDUPOIS OUNCES INTO GRAINS AND GRAMMES—*continued.*

Oz. Av.	Oz. Av.	Grains.	Grammes.	Apothecaries' Weight.			
				℥	ʒ	℈	grains.
30¼	30·5	13343·75	864·6604	27	6	1	3·75
30¾	30·75	13453·125	871·7477	28	0	0	13·125
31	31·0	13562·5	878·8351	28	2	0	2·5
31¼	31·25	13671·875	885·9225	28	3	2	11·875
31½	31·5	13781·25	893·0099	28	5	2	1·25
31¾	31·75	13890·625	900·0973	28	7	1	10·625
32	32·0	14000·0	907·1846	29	1	1	0·0
32¼	32·25	14109·375	914·2720	29	3	0	9·375
32½	32·5	14218·75	921·3594	29	4	2	18·75
32¾	32·75	14328·125	928·4468	29	6	2	8·125
33	33·0	14437·5	935·5312	30	0	1	17·5
33¼	33·25	14546·875	942·6215	30	2	1	6·875
33½	33·5	14656·25	949·7089	30	4	0	16·25
33¾	33·75	14765·625	956·7963	30	6	0	5·625
34	34·0	14875·0	963·8837	30	7	2	15·0
34¼	34·25	14984·375	970·9711	31	1	2	4·375
34½	34·5	15093·75	978·0584	31	3	1	13·75
34¾	34·75	15203·125	985·1458	31	5	1	3·125
35	35·0	15312·5	992·2332	31	7	0	12·5
35¼	35·25	15421·875	999·3206	32	1	0	1·875
35½	35·5	15531·25	1006·4080	32	2	2	11·25
35¾	35·75	15640·625	1213·4953	32	4	2	0·625
36	36·0	15750·0	1020·5827	32	6	1	10·0

SECTION IV.

(A) *THERMOMETRY.*

TABLES FOR THE CONVERSION OF THERMOMETRIC DEGREES.

Comparison of Centigrade with Fahrenheit.

To convert—

°C. to °R., multiply by 4 and divide by 5.
°C. to °F., multiply by 9, divide by 5, then add 32.
°R. to °C., multiply by 5 and divide by 4.
°R. to °F., multiply by 9, divide by 4, then add 32.
°F. to °R., first subtract 32, then multiply by 4 and divide by 9.
°F. to °C., first subtract 32, then multiply by 5 and divide by 9.

C.	F.	C.	F.	C.	F.
−40	−40	−31·1111	−24	−22·2222	−8
−39·4444	−39	−31	−23·8	−22	−7·6
−39	−38·2	−30·5556	−23	−21·6667	−7
−38·8889	−38	−30	−22	−21·1111	−6
−38·3333	−37	−29·4444	−21	−21	−5·8
−38	−36·4	−29	−20·2	−20·5556	−5
−37·7778	−36	−28·8889	−20	−20	−4
−37·2222	−35	−28·3333	−19	−19·4444	−3
−37	−34·6	−28	−18·4	−19	−2·2
−36·6667	−34	−27·7778	−18	−18·8889	−2
−36·1111	−33	−27.2222	−17	−18·3333	−1
−36	−32·8	−27	−16·6	−18	−0·4
−35·5556	−32	−26·6667	−16	−17·7778	0
−35	−31	−26·1111	−15	−17·2222	1
−34·4444	−30	−26	−14·8	−17	1·4
−34	−29·2	−25·5556	−14	−16·6667	2
−33·8889	−29	−25	−13	−16·1111	3
−33·3333	−28	−24·4444	−12	−16	3·2
−33	−27·4	−24	−11·2	−15·5556	4
−32·7778	−27	−23·8889	−11	−15	5
−32·2222	−26	−23·3333	−10	−14·4444	6
−32	−25·6	−23	− 9·4	−14	6·8
−31·6667	−25	−22·7778	− 9	−13·8889	7

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
−13·3333	8	2·2222	36	18	64·4
−13	8·6	2·7778	37	18·3333	65
−12·7778	9	3	37·4	18·8889	66
−12·2222	10	3·3333	38	19	66·2
−12	10·4	3·8889	39	19·4444	67
−11·6667	11	4	39·2	20	68
−11·1111	12	4·4444	40	20·5556	69
−11	12·2	5	41	21	69·8
−10·5556	13	5·5556	42	21·1111	70
−10	14	6	42·8	21·6667	71
− 9·4444	15	6·1111	43	22	71·6
− 9	15·8	6·6667	44	22·2222	72
− 8·8889	16	7	44·6	22·7778	73
− 8·3333	17	7·2222	45	23	73·4
− 8	17·6	7·7778	46	23·3333	74
− 7·7778	18	8	46·4	23·8889	75
− 7·2222	19	8·3333	47	24	75·2
− 7	19·4	8·8889	48	24·4444	76
− 6·6667	20	9	48·2	25	77
− 6·1111	21	9·4444	49	25·5556	78
− 6	21·2	10	50	26	78·8
− 5·5556	22	10·5556	51	26·1111	79
− 5	23	11	51·8	26·6667	80
− 4·4444	24	11·1111	52	27	80·6
− 4	24·8	11·6667	53	27·2222	81
− 3·8889	25	12	53·6	27·7778	82
− 3·3333	26	12·2222	54	28	82·4
− 3	26·6	12·7778	55	28·3333	83
− 2·7778	27	13	55·4	28·8889	84
− 2·2222	28	13·3333	56	29	84·2
− 2	28·4	13·8889	57	29·4444	85
− 1·6667	29	14	57·2	30	86
− 1·1111	30	14·4444	58	30·5556	87
− 1	30·2	15	59	31	87·8
− 0·5556	31	15·5556	60	31·1111	88
0	32	16	60·8	31·6667	89
0·5556	33	16·1111	61	32	89·6
1	33·8	16·6667	62	32·2222	90
1·1111	34	17	62·6	32·7778	91
1·6667	35	17·2222	63	33	91·4
2	35·6	17·7778	64	33·3333	92

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
33·8889	93	49·4444	121	65·5556	150
34	93·2	50	122	66	150·8
34·4444	94	50·5556	123	66·1111	151
35	95	51	123·8	66·6667	152
35·5556	96	51·1111	124	67	152·6
36	96·8	51·6667	125	67·2222	153
36·1111	97	52	125·6	67·7778	154
36·6667	98	52·2222	126	68	154·4
37	98·6	52·7778	127	68·3333	155
37·2222	99	53	127·4	68·8889	156
37·7778	100	53·3333	128	69	156·2
38	100·4	53·8889	129	69·4444	157
38·3333	101	54	129·2	70	158
38·8889	102	54·4444	130	70·5556	159
39	102·2	55	131	71	159·8
39·4444	103	55·5556	132	71·1111	160
40	104	56	132·8	71·6667	161
40·5556	105	56·1111	133	72	161·6
41	105·8	56·6667	134	72·2222	162
41·1111	106	57	134·6	72·7778	163
41·6667	107	57·2222	135	73	163·4
42	107·6	57·7778	136	73·3333	164
42·2222	108	58	136·4	73·8889	165
42·7778	109	58·3333	137	74	165·2
43	109·4	58·8889	138	74·4444	166
43·3333	110	59	138·2	75	167
43·8889	111	59·4444	139	75·5556	168
44	111·2	60	140	76	168·8
44·4444	112	60·5556	141	76·1111	169
45	113	61	141·8	76·6667	170
45·5556	114	61·1111	142	77	170·6
46	114·8	61·6667	143	77·2222	171
46·1111	115	62	143·6	77·7778	172
46·6667	116	62·2222	144	78	172·4
47	116·6	62·7778	145	78·3333	173
47·2222	117	63	145·4	78·8889	174
47·7778	118	63·3333	146	79	174·2
48	118·4	63·8889	147	79·4444	175
48·3333	119	64	147·2	80	176
48·8889	120	64·4444	148	80·5556	177
49	120·2	65	149	81	177·8

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
81·1111	178	97	206·6	112·7778	235
81·6667	179	97·2222	207	113	235·4
82	179·6	97·7778	208	113·3333	236
82·2222	180	98	208·4	113·8889	237
82·7778	181	98·3333	209	114	237·2
83	181·4	98·8889	210	114·4444	238
83·3333	182	99	210·2	115	239
83·8889	183	99·4444	211	115·5556	240
84	183·2	100	212	116	240·8
84·4444	184	100·5556	213	116·1111	241
85	185	101	213·8	116·6667	242
85·5556	186	101·1111	214	117	242·6
86	186·8	101·6667	215	117·2222	243
86·1111	187	102	215·6	117·7778	244
86·6667	188	102·2222	216	118	244·4
87	188·6	102·7778	217	118·3333	245
87·2222	189	103	217·4	118·8889	246
87·7778	190	10333333	218	119	246·2
88	190·4	103·8889	219	119·4444	247
88·3333	191	104	219·2	120	248
88·8889	192	104·4444	220	120·5556	249
89	192·2	105	221	121	249·8
89·4444	193	105·5556	222	121·1111	250
90	194	106	222·8	121·6667	251
90·5556	195	106·1111	223	122	251·6
91	195·8	106·6667	224	122·2222	252
91·1111	196	107	224·6	122·7778	253
91·6667	197	107·2222	225	123	253·4
92	197·6	107·7778	226	123·3333	254
92·2222	198	108	226·4	123·8889	255
92·7778	199	108·3333	227	124	255·2
93	199·4	108·8889	228	124·4444	256
93·3333	200	109	228·2	125	257
93·8889	201	109·4444	229	125·5556	258
94	201·2	110	230	126	258·8
94·4444	202	110·5556	231	126·1111	259
95	203	111	231·8	126·6667	260
95·5556	204	111·1111	232	127	260·6
96	204·8	111·6067	233	127·2222	261
96·1111	205	112	233·6	127·7778	262
96·6667	206	112·2222	234	128	262·4

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
128·3333	263	144	291·2	160	320
128·8889	264	144·4444	292	160·5556	321
129	264·2	145	293	161	321·8
129·4444	265	145·5556	294	161·1111	322
130	266	146	294·8	161·6667	323
130·5556	267	146·1111	295	162	323·6
131	267·8	146·6667	296	162·2222	324
131·1111	268	147	296·6	162·7778	325
131·6667	269	147·2222	297	163	325·4
132	269·6	147·7778	298	163·3333	326
132·2222	270	148	298·4	163·8889	327
132·7778	271	148·3333	299	164	327·2
133	271·4	148·8889	300	164·4444	328
133·3333	272	149	300·2	165	329
133·8889	273	149·4444	301	165·5556	330
134	273·2	150	302	166	330·8
134·4444	274	150·5556	303	166·1111	331
135	275	151	303·8	166·6667	332
135·5556	276	151·1111	304	167	332·6
136	276·8	151·6667	305	167·2222	333
136·1111	277	152	305·6	167·7778	334
136·6667	278	152·2222	306	168	334·4
137	278·6	152·7778	307	168·3333	335
137·2222	279	153	307·4	168·8889	336
137·7778	280	153·3333	308	169	336·2
138	280·4	153·8889	309	169·4444	337
138·3333	281	154	309·2	170	338
138·8889	282	154·4444	310	170·5556	339
139	282·2	155	311	171	339·8
139·4444	283	155·5556	312	171·1111	340
140	284	156	312·8	171·6667	341
140·5556	285	156·1111	313	172	341·6
141	285·8	156·6667	314	172·2222	342
141·1111	286	157	314·6	172·7778	343
141·6667	287	157·2222	315	173	343·4
142	287·6	157·7778	316	173·3333	344
142·2222	288	158	316·4	173·8889	345
142·7778	289	158·3333	317	174	345·2
143	289·4	158·8889	318	174·4444	346
143·3333	290	159	318·2	175	347
143·8889	291	159·4444	319	175·5556	348

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
176	348·8	191·6667	377	207·2222	405
176·1111	349	192	377·6	207·7778	406
176·6667	350	192·2222	378	208	406.4
177	350·6	192·7778	379	208·3333	407
177·2222	351	193	379·4	208·8889	408
177·7778	352	193·3333	380	209	408·2
178	352·4	193·8889	381	209·4444	409
178·3333	353	194	381·2	210	410
178·8889	354	194·4444	382	210·5556	411
179	354·2	195	383	211	411·8
179·4444	355	195·5556	384	211·1111	412
180	356	196	384·8	211·6667	413
180·5556	357	196·1111	385	212	413·6
181	357·8	196·6667	386	212·2222	414
181·1111	358	197	386·6	212·7778	415
181·6667	359	197·2222	387	213	415·4
182	359·6	397·7778	388	213·3333	416
182·2222	360	198	388·4	213·8889	417
182·7778	361	198·3333	389	214	417·2
183	361·4	198·8889	390	214·4444	418
183·3333	362	199	390·2	215	419
183·8889	363	199·4444	391	215·5556	420
184	363·2	200	392	216	420·8
184·4444	364	200·5556	393	216·1111	421
185	365	201	393·8	216·6667	422
185·5556	366	201·1111	394	217	422·6
186	366·8	201·6667	395	217·2222	423
186·1111	367	202	395·6	217·7778	424
186·6667	368	202·2222	396	218	424·4
187	368·6	202·7778	397	218·3333	425
187·2222	369	203	397·4	218·8889	426
187·7778	370	203·3333	398	219	426·2
188	370·4	203·8889	399	219·4444	427
188·3333	371	204	399·2	220	428
188·8889	372	204·4444	400	220·5556	429
189	72·2	205	401	221	429·8
189·4444	373	205·5556	402	221·1111	430
190	373·4	206	402·8	221·6667	431
190·5556	375	206·1111	403	222	431·6
191	375·8	206·6667	404	222·2222	432
191·1111	376	207	404·6	222·7778	433

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
223	433·4	238·8889	462	254·4444	490
223·3333	434	239	462·2	255	491
223·8889	435	239·4444	463	255·5556	492
224	435·2	240	464	256	492·8
224·4444	436	240·5556	465	256·1111	493
225	437	241	465·8	256·6667	494
225·5556	438	241·1111	466	257	494·6
226	438·8	241·6667	467	257·2222	495
226·1111	439	242	467·6	257·7778	496
226·6667	440	242·2222	468	258	496·4
227	440·6	242·7778	469	258·3333	497
227·2222	441	243	469·4	258·8889	498
227·7778	442	243·3333	470	259	498·2
228	442·4	243·8889	471	259·4444	499
228·3333	443	244	471·2	260	500
228·8889	444	244·4444	472	260·5556	501
229	444·2	245	473	261	501·8
229·4444	445	245·5556	474	261·1111	502
230	446	246	474·8	261·6667	503
230·5556	447	246·1111	475	262	503·6
231	447·8	246·6667	476	262·2222	504
231·1111	448	247	476·6	262·7778	505
231·6667	449	247·2222	477	263	505·4
232	449·6	247·7778	478	263·3333	506
232·2222	450	248	478·4	263·8889	507
232·7778	451	248·3333	479	264	507·2
233	451·4	248·8889	480	264·4444	508
233·3333	452	249	480·2	265	509
233·8889	453	249·4444	481	265·5556	510
234	453·2	250	482	266	510·8
234·4444	454	250·5556	483	266·1111	511
235	455	251	483·8	266·6667	512
235·5556	456	251·1111	484	267	512·6
236	456·8	251·6667	485	267·2222	513
236·1111	457	252	485·6	267·7778	514
236·6667	458	252·2222	486	268	514·4
237	458·6	252·7778	487	268·3333	515
237·2222	459	253	487·4	268·8889	516
237·7778	460	253·3333	488	269	516·2
238	460·4	253·8889	489	269·4444	517
238·3333	461	254	489·2	270	518

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
270·5556	519	286·1111	547	302	575·6
271	519·8	286·6667	548	302·2222	576
271·1111	520	287	548·6	302·7778	577
271·6667	521	287·2222	549	303	577·4
272	521·6	287·7778	550	303·3333	578
272·2222	522	288	550·4	303·8889	579
272·7778	523	288·3333	551	304	579·2
273	523·4	288·8889	552	304·4444	580
273·3333	524	289	552·2	305	581
273·8889	525	289·4444	553	305·5556	582
274	525·2	290	554	306	582·8
274·4444	526	290·5556	555	306·1111	583
275	527	291	555·8	306·6667	584
275·5556	528	291·1111	556	307	584·6
276	528·8	291·6667	557	307·2222	585
276·1111	529	292	557·6	307·7778	586
276·6667	530	292·2222	558	308	586·4
277	530·6	292·7778	559	308·3333	587
277·2222	531	293	559·4	308·8889	588
277·7778	532	293·3333	560	309	588·2
278	532·4	293·8889	561	309·4444	589
278·3333	533	294	561·2	310	590
278·8889	534	294·4444	562	310·5556	591
279	534·2	295	563	311	591·8
279·4444	535	295·5556	564	311·1111	592
280	536	296	564·8	311·6667	593
280·5556	537	296·1111	565	312	593·6
281	537·8	296·6667	566	312·2222	594
281·1111	538	297	566·6	312·7778	595
281·6667	539	297·2222	567	313	595·4
282	539·6	297·7778	568	313·3333	596
282·2222	540	298	568·4	313·8889	597
282·7778	541	298·3333	569	314	597·2
283	541·4	298·8889	570	314·4444	598
283·3333	542	299	570·2	315	599
283·8889	543	299·4444	571	315·5556	600
284	543·2	300	572	316	600·8
284·4444	544	300·5556	573	316·1111	601
285	545	301	573·8	316·6667	602
285·5556	546	301·1111	574	317	602·6
286	546·8	301·6667	575	317·2222	603

CONVERSION OF THERMOMETRIC DEGREES—*continued.*

C.	F.	C.	F.	C.	F.
317·7778	604	332	629·6	346·1111	655
318	604·4	332·2222	630	346·6667	656
318·3333	605	332·7778	631	347	656·6
318·8889	606	333	631·4	347·2222	657
319	606·2	333·3333	632	347·7778	658
319·4444	607	333·8889	633	348	658·4
320	608	334	633·2	348·3333	659
320·5556	609	334·4444	634	348·8889	660
321	609·8	335	635	349	660·2
321·1111	610	335·5556	636	349·4444	661
321·6667	611	336	636·8	350	662
322	611·6	336·1111	637	350·5556	663
322·2222	612	336·6667	638	351	663·8
332·7778	613	337	638·6	351·1111	664
323	613·4	337·2222	639	351·6667	665
323·3333	614	337·7778	640	352	665·6
323·8889	615	338	640·4	352·2222	666
324	615·2	338·3333	641	352·7778	667
324·4444	616	338·8889	642	353	667·4
325	617	339	642·2	353·3333	668
325·5556	618	339·4444	643	353·8889	669
326	618·8	340	644	354	669·2
326·1111	619	340·5556	645	354·4444	670
326·6667	620	341	645·8	355	671
327	620·6	341·1111	646	355·5556	672
327·2222	621	341·6667	647	356	672·8
327·7778	622	342	647·6	356·1111	673
328	622·4	342·2222	648	356·6667	674
328·3333	623	342·7778	649	357	674·6
328·8889	624	343	649·4	357·2222	675
329	624·2	343·3333	650	357·7778	676
329·4444	625	343·8889	651	358	676·4
330	626	344	651·2	358·3333	677
330·5556	627	344·4444	652	358·8889	678
331	627·8	345	653	359	678·2
331·1111	628	345·5556	654	359·4444	679
331·6667	629	346	654·8	360	680

Comparison of Réaumur Degrees with Centigrade and Fahrenheit Degrees.

R.	F.	C.	R.	F.	C.
+80	+212	+100	+52	+149	+65
79	209·75	98·75	51	146·75	63·75
78	207·50	97·50	50	144·50	62·50
77	205·25	96·25	49	142·25	61·25
76	203	95	48	140	60
75	200·75	93·75	47	137·75	58·75
74	198·50	92·50	46	135·50	57·50
73	196·25	91·25	45	133·25	56·25
72	194	90	44	131	55
71	191·75	88·75	43	128·75	53·75
70	189·50	87·50	42	126·50	52·50
69	187·25	86·25	41	124·25	51·25
68	185	85	40	122	50
67	182·75	83·75	39	119·75	48·75
66	180·50	82·50	38	117·50	47·50
65	178·25	81·25	37	115·25	46·25
64	176	80	36	113	45
63	173·75	78·75	35	110·75	43·75
62	171·50	77·50	34	108·50	42·50
61	169·25	76·25	33	106·25	41·25
60	167	75	32	104	40
59	164·75	73·75	31	101·75	38·75
58	162·50	72·50	30	99·50	37·50
57	160·25	71·25	29	97·25	36·25
56	158	70	28	95	35
55	155·75	68·75	27	92·75	33·75
54	153·50	67·50	26	90·50	32·50
53	151·25	66·25	25	88·25	31·25

COMPARISON OF RÉAUMUR DEGREES WITH CENTIGRADE AND FAHRENHEIT DEGREES—*continued.*

R.	F.	C.	R.	F.	C.
+24	+86	+30	+5	+20·75	+6·25
23	83·75	28·35	6	18·50	7·50
22	81·50	27·50	7	16·25	8·75
21	79·25	26·25	8	14	10
20	77	25	9	11·75	11·25
19	74·75	23·75	10	9·50	12·50
18	72·50	22·50	11	7·25	13·75
17	70·25	21·25	12	5	15
16	68	20	13	2·75	16·25
15	65·75	18·75	14	0·50	17·50
14	63·50	17·50	15	− 1·75	18·75
13	61·25	16·25	16	4	20
12	59	15	17	6·25	21·25
11	56·75	13·75	18	8·50	22·50
10	54·50	12·50	19	10·75	23·75
9	52·25	11·25	20	13	25
8	50	10	21	15·25	26·25
7	47·75	8·75	22	17·50	27·50
6	45·50	7·50	23	19·75	28·75
5	43·25	6·25	24	22	30
4	41	5	25	24·25	31·25
3	38·75	3·75	26	26·50	32·50
2	36·50	2·50	27	28·75	33·75
1	34·25	1·25	28	31	35
0	32	0	29	33·25	36·25
− 1	29·75	− 1·25	30	35·50	37·50
2	27·50	2·50	31	37·75	38·75
3	25·25	3·75	32	40	40
4	23	5			

TABLE SHOWING A COMPARISON OF THE DEGREES OF WEDGEWOOD'S PYROMETER WITH DEGREES C. AND DEGREES R.

Wedgewood.	°R.	°C.	
0	460	578	
1	518	648	Incipient glowing.
2	576	720	
3	634	793	Incipient cherry red.
4	692	865	
5	750	938	Red.
6	808	1010	
7	866	1083	Orange.
8	924	1155	Yellow.
9	982	1228	White.
10	1040	1300	Steel melts, 1350° C.
11	1098	1373	Strong white.
12	1156	1445	Dazzling white.
13	1214	1518	
14	1272	1590	
15	1330	1663	Wrought iron melts, 1600° C.
16	1388	1735	
17	1446	1808	
18	1504	1880	
19	1562	1953	
20	1620	2023	
21	1678	2098	
22	1736	2170	
23	1794	2243	
24	1852	2315	
25	1910	2388	
26	1968	2460	
27	2026	2533	
28	2084	2605	
29	2142	2678	
30	2200	2750	

TABLE FOR THE CORRECTION OF THERMOMETERS IN DETERMINATION OF BOILING POINTS, ETC.

T being the temperature indicated by the thermometer.

N the number of degrees occupying the length of the mercurial column projecting out of the apparatus, &c.

t the temperature of the column taken as the point $T - \frac{1}{2} N$, then the following corrections must be added to T.

N.	$T - t = 20°$.	50°.	80°.	100°.	120°.
20	0·06	0·15	0·25	0·31	0·37
40	0·12	0·31	0·50	0·62	0·74
60	0·18	0·46	0·74	0·92	1·11
80	0·25	0·62	0·99	1·23	1·48
100	0·31	0·77	1·23	1·54	1·85
120	0·37	0·92	1·48	1·85	2·26
140	0·43	1·08	1·72	2·16	2·59
160	0·49	1·23	1·97	2·46	2·96
180	0·56	1·39	2·22	2·77	3·33
200	0·62	1·54	2·46	3·08	3·70

The following table affords a somewhat rough method of estimating high temperatures:—

	°C.		°C.
Just glowing in the dark ..	525	Bright cherry red	1000
Dark red	700	Orange	1150
Cherry red ..	908	White	1300
		Dazzling white	1500

COMPARISON OF DEGREES OF THE AIR THERMOMETER WITH DEGREES OF THE MERCURIAL THERMOMETER.

Hg.	34 Per Cent. PbO.	Ordinary Soda Glass.	Magnus.	Hg.	34 Per Cent. PbO.	Ordinary Soda Glass.	Magnus.
100	100	100		230	227·91	230·45	
110	109·95	110·02		240	237·55	240·40	
120	119·88	120·05		250	247·13	249·95	245 39
130	129·80	130·09		260	256·71	259·80	
140	139·73	140·15		270	266·27	269·63	
150	149·60	150·20	148·74	280	275·77	279·49	
160	159·49	160·26		290	285 20	289·22	
170	169·36	170·32		300	294·61	298·95	294·51
180	179·21	180·37		310	303·99	318·60	
190	189·01	190·37		320	313·29	308·26	
200	198·78	200·30	197·49	330	322·51	327·74	320·92
210	208·51	210·25		340	331·61	337·17	
220	218·23	220·20		350	340·62	346·35	

The column Hg shows the degrees of mercurial thermometer.

The second column shows the degrees of the air thermometer corresponding to the degrees of a mercurial thermometer made of glass containing 34 per cent. PbO.

The third column shows the comparison when the glass used is ordinary soda glass.

The fourth column are values given by Magnus.

WALKER'S LIST OF FRIGORIFIC MIXTURES.

		Thermometer sinks Degrees F.
Ammonium Nitrate	1 part	From + 40° to + 4°
Water	1 "	
Ammonium Chloride	5 parts	From + 50° to + 10°
Potassium Nitrate	5 "	
Water	16 "	
Ammonium Chloride	5 parts	From + 50° to + 4°
Potassium Nitrate	5 "	
Sodium Sulphate	8 "	
Water	16 "	
Sodium Nitrate	3 parts	From + 50° to − 3°
Nitric acid, diluted	2 "	
Ammonium Nitrate	1 part	From + 50° to − 7°
Sodium Carbonate	1 "	
Water	1 "	
Sodium Phosphate	9 parts	From + 50° to − 12°
Nitric acid, diluted	4 "	
Sodium Sulphate	5 parts	From + 50° to + 3°
Sulphuric acid, diluted	4 "	
Sodium Sulphate	6 parts	From + 50° to − 10°
Ammonium Chloride	4 "	
Potassium Nitrate	2 "	
Nitric acid, diluted	4 "	
Sodium Sulphate	6 parts	From + 50° to − 40°
Ammonium Nitrate	5 "	
Nitric acid, diluted	4 "	

WALKER'S LIST OF FRIGORIFIC MIXTURES—*continued.*

		Thermometer sinks Degrees F.
Snow, or pounded ice	2 parts	to – 5°
Sodium Chloride	1 ,,	
Snow, or pounded ice	5 parts	to –12°
Sodium Chloride	2 ,,	
Ammonium Chloride	1 ,,	
Snow, or pounded ice	24 parts	to – 18°
Sodium Chloride	10 ,,	
Ammonium Chloride	5 ,,	
Potassium Nitrate	5 ,,	
Snow, or pounded ice	12 parts	to – 25°
Sodium Chloride	5 ,,	
Ammonium Nitrate	5 ,,	
Snow	3 parts	From + 32° to – 23°
Sulphuric acid, diluted ..	2 ,,	
Snow	8 parts	From + 32° to – 27°
Hydrochloric acid	5 ,,	
Snow	7 parts	From + 32° to – 30°
Nitric acid, diluted	4 ,,	
Snow	4 parts	From + 32° to – 40°
Calcium Chloride	5 ,,	
Snow	2 parts	From + 32° to – 50°
Calcium Chloride, crystallized	3 ,,	
Snow	3 parts	From + 32° to – 51°
Potash	4 ,,	

COMPARISON OF THE BRITISH AND METRICAL BAROMETERS.

Inches.	Milli-metres.	Inches.	Milli-metres.	Inches.	Milli-metres.
27·00	685·788	27·50	698·487	28·00	711·187
27·02	686·296	27·52	698·995	28·02	711·695
27·04	686·804	27·54	699·503	28·04	712·203
27·06	687·312	27·56	700·011	28·06	712·711
27·08	687·820	27·58	700·519	28·08	713·219
27·10	688·328	27·60	701·027	28·10	713·727
27·12	688·835	27·62	701·535	28·12	714·235
27·14	689·343	27·64	702·043	28·14	714·743
27·16	689·851	27·66	702·551	28·16	715·251
27·18	690·359	27·68	703·059	28·18	715·759
27·20	690·867	27·70	703·567	28·20	716·267
27·22	691·375	27·72	704·075	28·22	716·775
27·24	691·883	27·74	704·583	28·24	717·283
27·26	692·391	27·76	705·091	28·26	717·791
27·28	692·899	27·78	705·599	28·28	718·299
27·30	693·407	27·80	706·107	28·30	718·807
27·32	693·915	27·82	706·615	28·32	719·315
27·34	694·423	27·84	707·123	28·34	719·823
27·36	694·931	27·86	707·631	28·36	720·331
27·38	695·439	27·88	708·139	28·38	720·839
27·40	695·947	27·90	708·647	28·40	721·347
27·42	696·455	27·92	709·155	28·42	721·855
27·44	696·963	27·94	709·663	28·44	722·363
27·46	697·471	27·96	710·171	28·46	722·871
27·48	697·979	27·98	710·679	28·48	723·379

Comparison of the British and Metrical Barometers—*continued.*

Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.
28·50	723·887	29·00	736·587	29·50	749·286
28·52	724·395	29·02	737·095	29·52	749·794
28·54	724·903	29·04	737·603	29·54	750·302
28·56	725·411	29·06	738·111	29·56	750·810
28·58	725·919	29·08	738·619	29·58	751·318
28·60	726·427	29·10	739·127	29·60	751·826
28·62	726·935	29·12	739·635	29·62	752·334
28·64	727·443	29·14	740·143	29·64	752·842
28·66	727·951	29·16	740·651	29·66	753·350
28·68	728·439	29·18	741·159	29·68	753·858
28·70	728·967	29·20	741·667	29·70	754·366
28·72	729·475	29·22	742·175	29·72	754·874
28·74	729·983	29·24	742·683	29·74	755·382
28·76	730·491	29·26	743·191	29·76	755·890
28·78	730·999	29·28	743·699	29·78	756·398
28·80	731·507	29·30	744·206	29·80	756·906
28·82	732·015	29·32	744·714	29·82	757·414
28·84	732·523	29·34	745·222	29·84	757·922
28·86	733·031	29·36	745·730	29·86	758·430
28·88	733·539	29·38	746·228	29·88	758·938
28·90	734·047	29·40	746·746	29·90	759·446
28·92	734·551	29·42	747·254	29·92	759·954
28·94	735·063	29·44	747·762	29·94	760·462
28·96	735·571	29·46	748·270	29·96	760·970
28·98	736·079	29·48	748·778	29·98	761·478

COMPARISON OF THE BRITISH AND METRICAL BAROMETERS—*continued.*

Inches.	Millimetres.	Inches.	Millimetres.	Inches.	Millimetres.
30·00	761·986	30·34	770·622	30·68	779·258
30·02	762·494	30·36	771·130	30·70	779·766
30·04	763·002	30·38	771·638	30·72	780·274
30·06	763·510	30·40	772·146	30·74	780·782
30·08	764·018	30·42	772·654	30·76	781·290
30·10	764·526	30·44	773·162	30·78	781·798
30·12	765·034	30·46	773·670	30·80	782·306
30·14	765·542	30·48	774·178	30·82	782·814
30·16	766·050	30·50	774·686	30·84	783·322
30·18	766·558	30·52	775·194	30·86	783·830
30·20	767·066	30·54	775·702	30·88	784·338
30·22	767·574	30·56	776·210	30·90	784·846
30·24	768·082	30·58	776·718	30·92	785·354
30·26	768·590	30·60	777·226	30·94	785·862
30·28	769·098	30·62	777·734	30·96	786·370
30·30	769·606	30·64	778·242	30·98	786·878
30·32	770·114	30·66	778·750		

REDUCTION OF BAROMETERS TO 0° C. (Exact Formula).

$$h = \mathrm{H}\frac{5550}{5550 + t}\ (1\cdot + k\,t).$$

h = corrected heights.
H = observed height, corrected for capillarity.
t = temperature at time of observation.
k = coef. of linear expansion of scale for 1° C.
= ·000007567 for glass; ·000018782 for brass.

COMPARISON OF THE METRICAL AND BRITISH BAROMETERS.

Mm.	Inches.	Mm.	Inches.	Mm.	Inches.	Mm.	Inches.	Mm.	Inches.
700	27·56	718	28·27	736	28·98	754	29·69	772	30·39
701	·60	719	·31	737	29·02	755	·73	773	·43
702	·64	720	·35	738	·06	756	·76	774	·47
703	·68	721	·39	739	·10	757	·80	775	·51
704	·72	722	·43	740	·13	758	·84	776	·55
705	·76	723	·47	741	·17	759	·88	777	·59
706	·80	724	·50	742	·21	760	·92	778	·63
707	·84	725	·54	743	·25	761	·96	779	·67
708	·88	726	·58	744	·29	762	30·00	780	·71
709	·91	727	·62	745	·33	763	·04	781	·75
710	·95	728	·66	746	·37	764	·08	782	·79
711	·99	729	·70	747	·41	765	·12	783	·83
712	28·03	730	·74	748	·45	766	·16	784	·87
713	·07	731	·78	749	·49	767	·20	785	·91
714	·11	732	·82	750	·53	768	·24	786	·94
715	·15	733	·86	751	·57	769	·28	787	·98
716	·19	734	·90	752	·61	770	·32	788	31·02
717	·23	735	·94	753	·65	771	·36	789	·06

CORRECTION TO BE APPLIED TO BAROMETERS, THE SCALES OF WHICH ARE ENGRAVED ON GLASS, TO REDUCE THE OBSERVATIONS TO 32° F. (0° C.).

Temp. ° C.	Temp. ° F.	Inches, 28·0	Inches, 28·5	Inches, 29·0	Inches, 29·5	Inches, 30·0	Inches, 30·5	Inches, 31·0	Inches, 31·5
– 3·88	25	+ ·017	+ ·017	+ ·017	+ ·018	+ ·018	+ ·018	+ ·019	+ ·019
– 1·11	30	+ ·005	+ ·005	+ ·005	+ ·005	+ ·005	+ ·005	+ ·005	+ ·005
1·66	35	– ·007	– ·007	– ·007	– ·008	– ·008	– ·008	– ·008	– ·008
4·44	40	– ·019	– ·020	– ·020	– ·020	– ·021	– ·021	– ·021	– ·022
7·22	45	– ·031	– ·032	– ·032	– ·033	– ·033	– ·034	– ·035	– ·036
10·00	50	– ·043	– ·044	– ·045	– ·046	– ·046	– ·047	– ·048	– ·049
12·77	55	– ·055	– ·056	– ·057	– ·058	– ·059	– ·060	– ·061	– ·062
15·55	60	– ·067	– ·068	– ·069	– ·071	– ·072	– ·074	– ·075	– ·076
18·33	65	– ·079	– ·081	– ·082	– ·083	– ·085	– ·086	– ·088	– ·089
21·11	70	– ·091	– ·093	– ·094	– ·096	– ·098	– ·100	– ·101	– ·103
23·88	75	– ·103	– ·105	– ·106	– ·109	– ·111	– ·114	– ·116	– ·118

Corrections to be applied to Reduce Barometers to 0° C.

The correction is additive for negative degrees, and subtractive for positive degrees.

With Scales engraved on Glass.

Height observed=	700 mm.	705 mm.	710 mm.	715 mm.	720 mm.	725 mm.
$t = 1°$ C	·120	·121	·121	·122	·123	·124
2	·240	·241	·243	·245	·246	·248
3	·359	·362	·364	·367	·370	·372
4	·479	·483	·486	·489	·493	·496
5	·599	·603	·607	·612	·616	·620
6	·719	·724	·729	·734	·739	·744
7	·838	·844	·850	·856	·862	·868
8	·958	·965	·972	·979	·986	·992
9	1·078	1·086	1·093	1·101	1·109	1·116
10	1·198	1·206	1·215	1·223	1·232	1·240

Height observed=	730 mm.	735 mm.	740 mm.	745 mm.	750 mm.	755 mm.
$t = 1°$ C.	·125	·126	·127	·127	·128	·129
2	·250	·252	·258	·255	·257	·258
3	·375	·377	·380	·382	·385	·388
4	·500	·503	·506	·510	·513	·517
5	·625	·629	·633	·637	·642	·646
6	·749	·755	·760	·765	·770	·775
7	·874	·880	·886	·892	·898	·904
8	·999	1·006	1·013	1·020	1·027	1·033
9	1·124	1·132	1·140	1·147	1·155	1·163
10	1·249	1·258	1·266	1·275	1·283	1·292

Height observed=	760 mm.	765 mm.	770 mm.	775 mm.	780 mm.
$t = 1°$ C.	·130	·131	·132	·133	·133
2	·260	·262	·263	·265	·267
3	·390	·393	·395	·398	·400
4	·520	·524	·527	·530	·534
5	·650	·654	·659	·663	·667
6	·780	·785	·790	·796	·801
7	·810	·916	·922	·928	·934
8	1·040	1·047	1·054	1·061	1·068
9	1·170	1·178	1·186	1·193	1·201
10	1·300	1·309	1·317	1·326	1·335

CORRECTIONS TO BE APPLIED TO BAROMETERS—*continued.*

The correction is additive for negative degrees, and subtractive for positive degrees.

With Scales engraved on Brass.

Height observed=	700 mm.	705 mm.	710 mm.	715 mm.	720 mm.	725 mm.
$t = 1°$ C.	·1130	·1138	·1146	·1154	·1162	·1170
2	·226	·228	·229	·231	·232	·234
3	·339	·341	·344	·346	·349	·351
4	·452	·455	·458	·462	·465	·468
5	·565	·569	·573	·577	·581	·585
6	·678	·683	·688	·692	·697	·702
7	·791	·797	·802	·808	·813	·819
8	·904	·910	·917	·923	·930	·936
9	1·017	1·024	1·031	1·039	1·046	1·053

Height observed=	730 mm.	735 mm.	740 mm.	745 mm.	750 mm.	755 mm.
$t = 1°$ C.	·1128	·1186	·1194	·1202	·1210	·1218
2	·236	·237	·239	·240	·242	·244
3	·353	·356	·358	·361	·363	·365
4	·471	·474	·478	·481	·484	·487
5	·589	·593	·597	·601	·605	·609
6	·707	·712	·716	·721	·726	·731
7	·825	·830	·836	·841	·847	·853
8	·942	·949	·955	·962	·968	·974
9	1·060	1·067	1·075	1·082	1·089	1·096

Height observed=	760 mm.	765 mm.	770 mm.	775 mm.	780 mm.
$t = 1°$ C.	·1227	·1235	·1243	·1251	·1259
2	·245	·247	·249	·250	·252
3	·368	·370	·373	·375	·378
4	·491	·494	·497	·500	·504
5	·613	·617	·621	·625	·629
6	·736	·741	·746	·751	·755
7	·859	·864	·870	·876	·881
8	·982	·988	·994	1·001	1·007
9	1·104	1·111	1·119	1·126	1·133

Correction to be Added to Barometers for Capillarity.

F = height of meniscus in mm. Correction is in mm.

Radius of Tube.	F=·2	·3	·4	·5	·6	·7	·8	·9	1·0	1·1	1·2	1·3	1·4	1·5	1·6
mm.															
2	·60	·89	1·16	1·41	1·65	1·86	2·05	2·21	2·35	—	—	—	—	—	—
2·2	·49	·72	·95	1·16	1·36	1·54	1·71	1·83	1·98	20·9	—	—	—	—	—
2·4	·40	·60	·79	·97	1·14	1·29	1·44	1·57	1·68	1·78	1·87	—	—	—	—
2·6	·34	·50	·66	·81	·96	1·09	1·22	1·33	1·44	1·53	1·61	1·68	—	—	—
2·8	·29	·43	·56	·69	·82	·93	1·04	1·14	1·24	1·32	1·39	1·46	1·51	—	—
3	·24	·36	·48	·59	·70	·80	·90	·99	1·07	1·14	1·21	1·27	1·32	1·37	—
3·2	·21	·31	·41	·51	·60	·69	·78	·86	·93	1·00	1·06	1·11	1·16	1·20	1·24
3·4	·18	·27	·36	·44	·52	·60	·68	·75	·81	·87	·93	·98	1·02	1·06	1·10
3·6	·16	·23	·31	·38	·46	·52	·59	·65	·71	·76	·81	·86	·90	·94	·97
3·8	·14	·21	·27	·34	·40	·46	·52	·57	·62	·67	·72	·76	·80	·83	·86
4	·12	·18	·24	·30	·35	·40	·46	·50	·55	·59	·64	·67	·71	·74	·77
4·2	·11	·16	·21	·26	·31	·36	·40	·45	·49	·53	·56	·60	·63	·66	·68
4·4	·09	·14	·19	·23	·27	·32	·36	·40	·45	·47	·50	·53	·56	·59	·61
4·6	·08	·12	·16	·20	·24	·28	·32	·35	·38	·42	·45	·47	·50	·52	·54
4·8	·07	·11	·15	·18	·22	·25	·28	·31	·34	·37	·40	·42	·45	·47	·49
5	·07	·10	·13	·16	·19	·22	·25	·28	·31	·33	·35	·38	·40	·42	·44
5·2	·06	·09	·12	·14	·17	·20	·22	·25	·27	·30	·32	·34	·36	·37	·39
5·4	·05	·08	·10	·13	·15	·18	·20	·22	·24	·26	·28	·30	·32	·34	·35
5·6	·05	·07	·09	·12	·14	·16	·18	·20	·22	·24	·26	·27	·29	·30	·32
5·8	·04	·06	·08	·10	·12	·14	·16	·18	·20	·21	·23	·24	·26	·27	·28
6	·04	·06	·07	·09	·11	·13	·14	·16	·18	·19	·21	·22	·23	·24	·25

TABLE I.—FOR DEW POINT.

To obtain the dew point, multiply the difference of reading of the thermometers by the factor opposite the dry-bulb reading and subtract the product from the dry-bulb reading.

Dry-bulb Ther. F.	Factor.	Dry-bulb Ther. F.	Factor.	Dry-bulb Ther. F.	Factor.	Dry-bulb Ther. F.	Factor.
10	8·78	33	3·01	56	1·94	78	1·69
11	8·78	34	2·77	57	1·92	79	1·69
12	8·78	35	2·60	58	1·90	80	1·68
13	8·77	36	2·50	59	1·89	81	1·68
14	8·76	37	2·42	60	1·88	82	1·67
15	8·75	38	2·36	61	1·87	83	1·67
16	8·70	39	2·32	62	1·86	84	1·66
17	8·62	40	2·29	63	1·85	85	1·65
18	8·50	41	2·26	64	1·83	86	1·65
19	8·34	42	2·23	65	1·82	87	1·64
20	8·14	43	2·20	66	1·81	88	1·64
21	7·88	44	2·18	67	1·80	89	1·63
22	7·60	45	2·16	68	1·79	90	1·63
23	7·28	46	2·14	69	1·78	91	1·62
24	6·92	47	2·12	70	1·77	92	1·62
25	6·53	48	2·10	71	1·76	93	1·61
26	6·08	49	2·08	72	1·75	94	1·60
27	5·61	50	2·06	73	1·74	95	1·60
28	5·12	51	2·04	74	1·73	96	1·59
29	4·63	52	2·02	75	1·72	97	1·59
30	4·15	53	2·00	76	1·71	98	1·58
31	3·70	54	1·98	77	1·70	99	1·58
32	3·32	55	1·96				

TABLE II., SHOWING THE MAXIMUM ELASTIC FORCE OF AQUEOUS VAPOUR IN INCHES OF MERCURY FOR EVERY DEGREE FAHR., FROM 0° TO 100°.

Temp. Fahr.	Force of Vapour. Inch. of Mercury.	Diff.	Temp. Fahr.	Force of Vapour. Inch. of Mercury.	Diff.	Temp. Fahr.	Force of Vapour. Inch. of Mercury.	Diff.
0	·044	2	34	·196	8	68	·684	24
1	·046	2	35	·204	8	69	·708	25
2	·048	2	36	·212	8	70	·733	26
3	·050	2	37	·220	9	71	·759	26
4	·052	2	38	·229	9	72	·785	27
5	·054	3	39	·238	9	73	·812	28
6	·057	3	40	·247	10	74	·840	28
7	·060	2	41	·257	10	75	·868	29
8	·062	3	42	·267	10	76	·897	30
9	·065	3	43	·277	11	77	·927	31
10	·068	3	44	·288	11	78	·958	32
11	·071	3	45	·299	12	79	·990	33
12	·074	4	46	·311	12	80	1·023	34
13	·078	4	47	·323	12	81	1·057	35
14	·082	4	48	·335	13	82	1·092	36
15	·086	4	49	·348	13	83	1·128	37
16	·090	4	50	·361	13	84	1·165	38
17	·094	4	51	·374	14	85	1·203	39
18	·098	5	52	·388	15	86	1·242	40
19	·103	5	53	·403	15	87	1·282	41
20	·108	5	54	·418	15	88	1·323	43
21	·113	5	55	·433	16	89	1·366	44
22	·118	5	56	·449	16	90	1·410	45
23	·123	6	57	·465	17	91	1·455	46
24	·129	6	58	·482	18	92	1·501	47
25	·135	6	59	·500	18	93	1·548	48
26	·141	6	60	·518	19	94	1·596	50
27	·147	6	61	·537	19	95	1·646	51
28	·153	7	62	·556	20	96	1·697	54
29	·160	7	63	·576	20	97	1·751	55
30	·167	7	64	·596	21	98	1·806	56
31	·174	7	65	·617	22	99	1·862	56
32	·181	7	66	·639	22	100	1·918	
33	·188	8	67	·661	23			

TABLE III.—FOR DEW POINT.

Temperature, Fahr.	Weight of a Cubic Foot of Saturated Vapour.	Weight of a Cubic Foot of Dry Air.	Weight of a Cubic Foot of Air saturated with Vapour.	Temperature, Fahr.	Weight of a Cubic Foot of Saturated Vapour.	Weight of a Cubic Foot of Dry Air.	Weight of a Cubic Foot of Air saturated with Vapour.
	Grains.	Grains.	Grains.		Grains.	Grains.	Grains.
0	0·55	606·37	606·03	56	5·04	540·45	537·45
5	0·68	599·83	599·40	57	5·21	539·40	536·30
10	0·84	593·44	592·94	58	5·39	538·36	535·15
15	1·04	587·18	586·55	59	5·58	537·32	534·00
20	1·30	581·05	580·26	60	5·77	536·28	532·84
25	1·61	575·05	574·08	61	5·97	535·25	531·69
30	1·97	569·17	567·99	62	6·17	534·22	530·55
32	2·13	566·85	565·58	63	6·38	533·20	529·42
35	2·39	563·42	561·99	64	6·59	532·18	528·28
40	2·86	557·77	556·03	65	6·81	531·17	527·14
41	2·97	556·66	554·86	66	7·04	530·16	526·01
42	3·08	555·55	553·69	67	7·27	529·15	524·86
43	3·20	554·44	552·52	68	7·51	528·14	523·71
44	3·32	553·34	551·35	69	7·76	527·14	522·56
45	3·44	552·24	550·19	70	8·01	526·15	521·41
46	3·56	551·15	549·02	71	8·27	525·16	520·27
47	3·69	550·06	547·85	72	8·54	524·17	519·12
48	3·82	548·97	546·69	73	8·82	523·18	517·98
49	3·96	547·89	545·53	74	9·10	522·20	516·83
50	4·10	546·81	544·37	75	9·39	521·22	515·69
51	4·24	545·74	543·21	80	10·98	516·39	509·97
52	4·39	544·67	542·03	85	12·78	511·65	504·19
53	4·55	543·61	540·89	90	14·85	506·99	498·43
54	4·71	542·55	539·75	95	17·18	502·41	492·56
55	4·87	541·50	538·60	100	19·84	497·93	486·65

SECTION V.

SPECIFIC GRAVITY, HYDROMETRY AND SPECIFIC GRAVITY OF SOLUTIONS.

(A) *SPECIFIC GRAVITY.*

DETERMINATION OF SPECIFIC GRAVITY.

Solids.

1. Solids heavier than, and insoluble in, water.

   a. By weighing in air and water.

$$\text{Sp. gr.} = \frac{\text{(weight in air)}}{\text{(loss of weight in water)}}.$$

   b. By Nicholson's hydrometer.

Let w_1 be the weight required to sink the instrument to the mark on the stem, the weight of the instrument being W; to take the specific gravity of any solid substance, place a portion of it weighing less than w_1 in the upper pan, with such additional weight, say w_3, as will cause the instrument to sink to the zero mark. The weight of the substance is then $w_1 - w_3$. Next transfer the substance to the lower pan, and again adjust with weight w_4 to the zero mark.

$$\text{Sp. gr.} = \frac{w_1 - w_3}{w_4 - w_3}.$$

   c. By the specific gravity bottle (applicable to powders).

Weigh the flask filled to the mark with water, then place the substance, of known weight, in the flask, fill to the mark with water, and weigh again.

2. Solids lighter than, and insoluble in, water.

The solid is weighted by a piece of lead of known specific gravity, and weighed in water.

$$\text{Sp. gr.} = \frac{\text{(weight of substance in air)}}{\text{(weight of lead in water)} - \text{(weight of lead and substance in water)} + \text{(weight of substance in air)}}.$$

3. Solids heavier than, and soluble in, water.

Proceed as in 1 *a*, using instead of water some liquid without action on the solid.

$$\text{(weight of bulk of liquid equal to substance)} = \text{(weight of substance in air)} - \text{(weight of substance in liquid)}.$$

$$\text{(weight of bulk of water equal to substance)} = \frac{\text{(weight of bulk of liquid equal to substance)} \times \text{(s p.}}{\text{(sp. gr. of liquid)}}.$$

$$\text{Sp. gr.} = \frac{\text{(weight of substance in air)}}{\text{(weight of bulk of water equal to substance)}}.$$

Liquids.

1. By the hydrometer.
2. By the specific gravity bottle.

Weigh the bottle filled to the mark with water, and again when filled to the mark with liquid.

$$\text{Sp gr} = \frac{\text{(weight of liquid and bottle)} - \text{(weight of bottle)}}{\text{(weight of water and bottle)} - \text{(weight of bottle)}}.$$

Gases.

For the description of the processes used in determining the specific gravity of gases, consult some standard work.

1. The method of Gay-Lussac.

We first determine the volume (V) occupied by a weight (W) of the substance at the temperature T, under a pressure P. The weight (W_1) of the same volume (V) of air, at the same temperature and pressure, is then found by the following formula:—

$$W_1 = {\cdot}0012932 \text{ gram} \;.\; V \;.\; \frac{1}{1 + {\cdot}00367\,T} \;.\; \frac{P}{760}.$$

$$\text{Sp. gr.} = \frac{W}{W'}.$$

For the Table by which to calculate $\left(\frac{1}{1 + {\cdot}00367\,T}\right)$, see Section VII.

2. The method of Dumas.

$$\text{Sp. gr.} = \frac{P + Vn_t}{(V - v)n_{t'}}$$

P = the difference in weight between the globe filled with air and filled with vapour.

V = capacity of balloon in cub. cent.
n_t = weight of 1 c.c. of air at the temperature of weighing the balloon filled with air.
$n_{t'}$ = weight of 1 c.c. of air at the temperature of sealing the globe.

For more exact formulæ, see Watts' 'Dictionary,' vol. v. 371, and Brown ('Chem. Soc. J.' [2], iv. 72).

For Tables by which to calculate n_t and $n_{t'}$, see page 346.

The method of V. Meyer and C. Meyer.

$$\text{Sp. gr.} = 587800 \frac{W(1 + \cdot 003665\, t)}{(B - w)\, V}.$$

W = weight of substance.
B = barometer pressure reduced to 0° C.
w = tension of water at t° C.
V = volume of displaced air.
t = temperature of observation.

SPECIFIC GRAVITIES OF SOME COMMON SUBSTANCES.

Anhydrous gypsum	2·96	Granite	2·5–2·9
Anthracite	1·4–1·7	Gun-metal	8·5
Asphalt	1·1–1·2	Gutta-percha	·996
Ash wood	·7– ·8	Gypsum	2·28
Beech wood (dry)	·7– ·8	India-rubber	·925
Birch wood (dry)	·7– ·8	Ivory	1·82
Brickwork	1·5–1·7	Larch wood	·44– ·5
Brown coal	1·2–1·4	Lime wood	·5
Brass	7·3–8·5	Marble	2·5–2·8
Chalk	1·8–2·7	Oak wood (dry)	·85–·95
Cement	2·7–3·05	Pine wood, white	·55
Charcoal (wood)	·3– ·5	Pine wood, red	·5
China clay	2·21	Poplar wood	·38
Clay	1·8–2·6	Porcelain	2·1–2·5
Coal (porous)	1·16–1·63	Sand, dry	1·4–1·6
Coke (porous)	·4	Sand, damp	1·9–2·0
Cork	·24	Sandstone	1·9–2·5
Elm wood	·67	Slate	2·5–2·8
Fat, animal	·92	Tile	1·8
Fir wood (dry)	6	Water, sea	1·027
Glass	2·6–3·4	Willow wood	·5–·58

(B) *HYDROMETRY.*

Baumé's Hydrometer or Areometer.—Several forms of this instrument are in use, which differ slightly among themselves according to the temperatures at which the scales are set. In the areometer for liquids lighter than water, the scale sinks to zero in a 10 per cent. solution of common salt, and stands at 10 in pure water. In the areometer for liquids heavier than water the zero is fixed for pure water, and the 10 per cent. solution indicates 10.

The so-called rational scale Baumé instrument (Kolb's) indicates zero in pure water at 15° C., and 66 in sulphuric acid of S.G. 1·842 at 15° C. This scale is in most common use on the Continent.

The Dutch areometer (*Pharmacopœia batava*) agrees with Baumé for liquids heavier than water, but for liquids lighter than water the scale stands at zero in pure water, so that the degrees are always 10 degrees less than the corresponding Baumé degrees.

Twaddell's Hydrometer, which is in common use in the British Empire, shows 200 degrees between S.G. 1·0 and S.G. 2·0; each degree therefore corresponds to 0·005 of S.G., and to convert Tw. degrees into S.G. it is merely necessary to multiply by 5 and then add 1000. The result thus obtained is S.G. compared with water = 1000.

Fleisoher's densimeter degrees correspond to 0·01 of S.G., and to convert them into S.G. it is merely necessary to place 1· before them, thus **D** 54 = S 1·54.

The degrees of the various areometers are calculated from the S.G. of the 10 per cent. salt solution by means of the formulæ given below, where n is the degree indicated on the Baumé or other instrument.

Temperature at which scale is fixed.		Specific Gravity of 10% Salt Solution.	Specific Gravity.	
			Liquids heavier than Water.	Liquids lighter than Water.
Baumé*	12·5° C. ..	1·073596	$\frac{145 \cdot 88}{145 \cdot 88 - n}$	$\frac{145 \cdot 88}{135 \cdot 88 + n}$
	15° C.	1·073350	$\frac{146 \cdot 3}{146 \cdot 3 - n}$	$\frac{146 \cdot 3}{146 \cdot 3 + n}$
	17·5° C. ..	1·073110	$\frac{146 \cdot 78}{146 \cdot 78 - n}$	$\frac{146 \cdot 78}{136 \cdot 78 + n}$
	Rational scale	..	$\frac{144 \cdot 3}{144 \cdot 3 - n}$	..
Cartier, 12·5° C. ..		..	$\frac{136 \cdot 8}{126 \cdot 1 - n}$	$\frac{136 \cdot 8}{126 \cdot 1 + n}$
Beck, 12·5° C. ..		..	$\frac{170}{170 - n}$	$\frac{170}{170 + n}$
Brix, 15·625° C ..		..	$\frac{400}{400 - n}$	$\frac{400}{400 + n}$
Balling		..	$\frac{200}{200 - n}$	$\frac{200}{200 + n}$
Gay-Lussac		..	$\frac{100}{100 - n}$	$\frac{100}{100 + n}$
Twaddell		..	$\frac{0 \cdot 5\,n + 100}{100}$	..

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* According to Baumé's original directions,

for liquids heavier than water $S.G. = \frac{149 \cdot 05}{149 \cdot 05 - n}$ temp 12·5°

American standard Baumé:

$$S.G. = \frac{145}{145 - n}, \text{ temp. } 60° \text{ F.}$$

COMPARISON OF THE HYDROMETER DEGREES ACCORDING TO BAUMÉ (RATIONAL SCALE) AND TWADDELL, WITH THE SPECIFIC GRAVITIES.

B.	T.	Sp. Gr.	B.	T.	Sp. Gr.	B.	T.	Sp. Gr.
0	0	1·000	15·0	23·2	1·116	28·8	50	1·250
0·7	1	1·005	15·4	24	1·120	29·0	50·4	1·252
1·0	1·4	1·007	16·0	25	1·125	29·3	51	1·255
1·4	2	1·010	16·5	26	1·130	29·7	52	1·260
2·0	2·8	1·014	17·0	26·8	1·134	30·0	52·6	1·263
2·1	3	1·015	17·1	27	1·135	30·2	53	1·265
2·7	4	1·020	17·7	28	1·140	30·6	54	1·270
3·0	4·4	1·022	18·0	28·4	1·142	31·0	54·8	1·274
3·4	5	1·025	18·3	29	1·145	31·1	55	1·275
4·0	5·8	1·029	18·8	30	1·150	31·5	56	1·280
4·1	6	1·030	19·0	30·4	1·152	32·0	57	1·285
4·7	7	1·035	19·3	31	1·155	32·4	58	1·290
5·0	7·4	1·037	19·8	32	1·160	32·8	59	1·295
5·4	8	1·040	20·0	32·4	1·162	33·0	59·4	1·297
6·0	9	1·045	20·3	33	1·165	33·3	60	1·300
6·7	10	1·050	20·9	34	1·170	33·7	61	1·305
7·0	10·2	1·052	21·0	34·2	1·171	34·0	61·6	1·308
7·4	11	1·055	21·4	35	1·175	34·2	62	1·310
8·0	12	1·060	22·0	36	1·180	34·6	63	1·315
8·7	13	1·065	22·5	37	1·185	35·0	64	1·320
9·0	13·4	1·067	23·0	38	1·190	35·4	65	1·325
9·4	14	1·070	23·5	39	1·195	35·8	66	1·330
10·0	15	1·075	24·0	40	1·200	36·0	66·4	1·332
10·6	16	1·080	24·5	41	1·205	36·2	67	1·335
11·0	16·6	1·083	25·0	42	1·210	36·6	68	1·340
11·2	17	1·085	25·5	43	1·215	37·0	69	1·345
11·9	18	1·090	26·0	44	1·220	37·4	70	1·350
12·0	18·2	1·091	26·4	45	1·225	37·8	71	1·355
12·4	19	1·095	26·9	46	1·230	38·0	71·4	1·357
13·0	20	1·100	27·0	46·2	1·231	38·2	72	1·360
13·6	21	1·105	27·4	47	1·235	38·6	73	1·365
14·0	21·6	1·108	27·9	48	1·240	39·0	74	1·370
14·2	22	1·110	28·0	48·2	1·241	39·4	75	1·375
14·9	23	1·115	28·4	49	1·245	39·8	76	1·380

COMPARISON OF THE HYDROMETER DEGREES, ETC.—*contd.*

B.	T.	Sp. Gr.	B.	T.	Sp. Gr.	B.	T.	Sp. Gr.
40·0	76·6	1·383	50·3	107	1·535	59·2	139	1·695
40·1	77	1·385	50·6	108	1·540	59·5	140	1·700
40·5	78	1·390	50·9	109	1·545	59·7	141	1·705
40·8	79	1·395	51·0	109·2	1·546	60·0	142	1·710
41·0	79·4	1·397	51·2	110	1·550	60·2	143	1·715
41·2	80	1·400	51·5	111	1·555	60·4	144	1·720
41·6	81	1·405	51·8	112	1·560	60·6	145	1·725
42·0	82	1·410	52·0	112·6	1·563	60·9	146	1·730
42·3	83	1·415	52·1	113	1·565	61·0	146·4	1·732
42·7	84	1·420	52·4	114	1·570	61·1	147	1·735
43·0	84·8	1·424	52·7	115	1·575	61·4	148	1·740
43·1	85	1·425	53·0	116	1·580	61·6	149	1·745
43·4	86	1·430	53·3	117	1·585	61·8	150	1·750
43·8	87	1·435	53·6	118	1·590	62·0	150·6	1·753
44·0	87·6	1·438	53·9	119	1·595	62·1	151	1·755
44·1	88	1·440	54·0	119·4	1·597	62·3	152	1·760
44·4	89	1·445	54·1	120	1·600	62·5	153	1·765
44·8	90	1·450	54·4	121	1·605	62·8	154	1·770
45·0	90·6	1·453	54·7	122	1·610	63·0	155	1·775
45·1	91	1·455	55·0	123	1·615	63·2	156	1·780
45·4	92	1·460	55·2	124	1·620	63·5	157	1·785
45·8	93	1·465	55·5	125	1·625	63·7	158	1·790
46·0	93·6	1·468	55·8	126	1·630	64·0	159	1·795
46·1	94	1·470	56·0	127	1·635	64·2	160	1·800
46·4	95	1·475	56·3	128	1·640	64·4	161	1·805
46·8	96	1·480	56·6	129	1·645	64·6	162	1·810
47·0	96·6	1·483	56·9	130	1·650	64·8	163	1·815
47·1	97	1·485	57·0	130·4	1·652	65·0	164	1·820
47·4	98	1·490	57·1	131	1·655	65·2	165	1·825
47·8	99	1·495	57·4	132	1·660	65·5	166	1·830
48·0	99·6	1·498	57·7	133	1·665	65·7	167	1·835
48·1	100	1·500	57·9	134	1·670	65·9	168	1·840
48·4	101	1·505	58·0	134·2	1·671	66·0	168·4	1·842
48·7	102	1·510	58·2	135	1·675	66·1	169	1·845
49·0	103	1·515	58·4	136	1·680	66·3	170	1·850
49·4	104	1·520	58·7	137	1·685	66·5	171	1·855
49·7	105	1·525	58·9	138	1·690	66·7	172	1·860
50·0	106	1·530	59·0	138·2	1·691	67·0	173	1·865

TABLE SHOWING A COMPARISON OF THE DEGREES OF BAUMÉ, CARTIER, AND BECK'S AREOMETERS, WITH SPECIFIC GRAVITY DEGREES.

A.—*For Liquids Lighter than Water.* Temp. 12·5° C.

Degs. of Baumé, Cartier, Beck.	Baumé.	Cartier.	Beck.	Degs. of Baumé, Cartier, Beck.	Baumé.	Cartier.	Beck.
	Sp. Gr.	Sp. Gr.	Sp. Gr.		Sp. Gr.	Sp. Gr.	Sp. Gr.
0	..	..	1·000	36	0·848	0·837	0·8252
1	..	..	0·9941	37	0·843	0·831	0·8212
2	..	..	0·9883	38	0·838	0·826	0·8173
3	..	..	0·9826	39	0·833	0·820	0·8133
4	..	..	0·9770	40	0·829	0·815	0·8095
5	..	..	0·9714	41	0·824	0·810	0·8061
6	..	..	0·9659	42	0·819	0·805	0·8018
7	..	..	9·9604	43	0·815	0·800	0·7981
8	..	..	0·9550	44	0·810	..	0·7944
9	..	..	0·9497	45	0·806	..	0·7907
10	1·000	..	0·9444	46	0·801	..	0·7871
11	0·993	1·000	0·9392	47	0·797	..	0·7834
12	0·986	0·992	0·9340	48	0·792	..	0·7799
13	0·979	0·985	0·9289	49	0·788	..	0·7763
14	0·973	0·977	0·9239	50	0·784	..	0·7727
15	0·967	0·969	0·9189	51	0·781	..	0·7692
16	0·960	0·962	0·9139	52	0·776	..	0·7658
17	0·954	0·955	0·9090	53	0·771	..	0·7623
18	0·948	0·948	0·9042	54	0·769	..	0·7589
19	0·942	0·941	0·8994	55	0·763	..	0·7556
20	0·935	0·934	0·8947	56	0·759	..	0·7522
21	0·929	0·927	0·8900	57	0·755	..	0·7489
22	0·924	0·920	0·8854	58	0·751	..	0·7456
23	0·918	0·914	0·8808	59	0·748	..	0·7423
24	0·912	0·908	0·8762	60	0·744	..	0·7391
25	0·906	0·901	0·8717	61	0·740	..	0·7359
26	0·901	0·895	0·8673	62	0·736	..	0·7328
27	0·895	0·889	0·8629	63	..	..	0·7296
28	0·889	0·883	0·8585	64	..	..	0·7265
29	0·884	0·877	0·8542	65	..	..	0·7234
30	0·879	0·871	0·8500	66	..	..	0·7203
31	0·873	0·865	0·8457	67	..	..	0·7173
32	0·868	0·859	0·8415	68	..	..	0·7142
33	0·863	0·853	0·8374	69	..	..	0·7112
34	0·858	0·848	0·8333	70	..	..	0·7083
35	0·853	0·842	0·8292				

TABLE SHOWING COMPARISON OF DEGREES—*continued.*

B.—*For Liquids Heavier than Water.*

Degs. of Baumé, Beck.	Baumé, 17·5° C.	Rational Scale, Baumé, 12·5° C.	Beck. 12·5° C.	Degs. of Baumé, Beck.	Baumé, 17·5° C.	Rational Scale, Baumé, 12·5° C.	Beck. 12·5° C.
	Sp. Gr.	Sp. Gr.	Sp. Gr.		Sp. Gr.	Sp. Gr.	Sp. Gr.
0	1·0000	1·0000	1·0000	37	1·3370	1·3447	1·2782
1	1·0068	1·0069	1·0059	38	1·3494	1·3574	1·2879
2	1·0138	1·0140	1·0119	39	1·3619	1·3703	1·2977
3	1·0208	1·0212	1·0180	40	1·3746	1·3834	1·3077
4	1·0280	1·0285	1·0241	41	1·3876	1·3968	1·3178
5	1·0353	1·0358	1·0303	42	1·4009	1·4105	1·3281
6	1·0425	1·0434	1·0366	43	1·4143	1·4244	1·3386
7	1·0501	1·0509	1·0429	44	1·4281	1·4386	1·3492
8	1·0576	1·0587	1·0494	45	1·4421	1·4531	1·3600
9	1·0653	1·0665	1·0559	46	1·4564	1·4678	1·3710
10	1·0731	1·0745	1·0625	47	1·4710	1·4828	1·3821
11	1·0810	1·0825	1·0692	48	1·4860	1·4984	1·3934
12	1·0890	1·0907	1·0759	49	1·5012	1·5141	1·4050
13	1·0972	1·0990	1·0828	50	1·5167	1·5301	1·3167
14	1·1054	1·1074	1·0897	51	1·5325	1·5466	1·4286
15	1·1138	1·1160	1·0968	52	1·5487	1·5633	1·4407
16	1·1224	1·1247	1·1039	53	1·5652	1·5804	1·4530
17	1·1310	1·1335	1·1111	54	1·5820	1·5978	1·4655
18	1·1398	1·1425	1·1184	55	1·5993	1·6158	1·4783
19	1·1487	1·1516	1·1258	56	1·6169	1·6342	1·4912
20	1·1578	1·1608	1·1333	57	1·6349	1·6529	1·5044
21	1·1670	1·1702	1·1409	58	1·6533	1·6720	1·5179
22	1·1763	1·1798	1·1486	59	1·6721	1·6916	1·5315
23	1·1858	1·1896	1·1565	60	1·6914	1·7116	1·5434
24	1·1955	1·1994	1·1644	61	1·7111	1·7322	1·5596
25	1·2053	1·2095	1·1724	62	1·7313	1·7532	1·5741
26	1·2153	1·2198	1·1806	63	1·7520	1·7748	1·5888
27	1·2254	1·2301	1·1888	64	1·7731	1·7960	1·6038
28	1·2357	1·2407	1·1972	65	1·7948	1·8195	1·6190
29	1·2462	1·2515	1·2057	66	1·8171	1·8428	1·6346
30	1·2569	1·2624	1·2143	67	1·8398	1·839	1·6505
31	1·2677	1·2736	1·2230	68	1·8632	1·864	1·6667
32	1·2788	1·2849	1·2319	69	1·8871	1·885	1·6832
33	1·2901	1·2965	1·2409	70	1·9117	1·909	1·7000
34	1·3015	1·3082	1·2500	71	1·9370	1·935	1·7272
35	1·3131	1·3202	1·2593	72	1·9629	1·960	1·7347
36	1·3250	1·3324	1·2687				

(C) *SPECIFIC GRAVITY OF SOLUTIONS.*

(Look under both acid and basic radicle for the salts of metals: thus Ferric Chloride under 'Iron,' Ferrous Sulphate under 'Sulphates.')

Acetates.

AMMONIUM ACETATE, $(NH_4)C_2H_3O_2$ + Aq at 16° C. (Hager).

Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.
5	1·012	20	1·042	30	1·062	40	1·0770
10	1·022	25	1·052	35	1·0695	50	1·0920
15	1·032						

BARIUM ACETATE, $Ba(C_2H_3O_2)_2$ + Aq at 15° C.

Per cent. of Anhy. Salt.	Sp. Gr.	Per cent. of Anhy, Salt.	Sp. Gr.	Per cent. of Anhy. Salt.	Sp. Gr.	Per cent. of Anhy. Salt.	Sp. Gr.
5	1·0436	15	1·1120	25	1·1952	35	1·2954
10	1·0758	20	1·1522	30	1·2402	40	1·3558

CALCIUM ACETATE, $Ca(C_2H_3O_2)_2$ + Aq at 15° C.

Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.
5	1·0260	15	1·0792	25	1·1321
10	1·0530	20	1·1051	30	1·1594

LEAD ACETATE, $Pb(C_2H_3O_2)_2$ + Aq at 15° C.

Per cent. of Anhy.	Per cent. of Salt, 3 Aq.	Sp. Gr.	Per cent. of Anhy.	Per cent. of Salt, 3 Aq.	Sp. Gr.
5	4·288	1·0319	30	25·727	1·2211
10	8·576	1·0654	35	30·015	1·2669
15	12·864	1·1010	40	34·303	1·3163
20	17·151	1·1384	45	38·591	1·3695
25	21·439	1·1784	50	42·879	1·4271

LEAD ACETATE, $Pb(C_2H_3O_2)_2$ + Aq at 20° C. (F. Salomon).

g. per 100 cm.^{3} —3 aq.	Sp. Gr.	g. per 100 cm.^{3} —3 aq.	Sp. Gr.	g. per 100 cm.^{3} —3 aq.	Sp. Gr.	g. per 100 cm.^{3} – 3 aq.	Sp. Gr.
1	1·0062	14	1·0870	27	1·1663	39	1·2380
2	1·0124	15	1·0932	28	1·1723	40	1·2440
3	1·0186	16	1·0994	29	1·1783	41	1·2499
4	1·0248	17	1·1056	30	1·1844	42	1·2558
5	1·0311	18	1·1118	31	1·1903	43	1·2617
6	1·0373	19	1·1180	32	1·1963	44	1·2676
7	1·0435	20	1·1242	33	1·2022	45	1·2735
8	1·0497	21	1·1302	34	1·2082	46	1·2794
9	1·0559	22	1·1362	35	1·2142	47	1·2853
10	1·0622	23	1·1422	36	1·2201	48	1·2912
11	1·0684	24	1·1482	37	1·2261	49	1·2971
12	1·0746	25	1·1543	38	1·2320	50	1·3030
13	1·0808	26	1·1603				

POTASSIUM ACETATE, $KC_2H_3O_2$ + Aq at 17·5° C. (Gerlach).

Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Anhy.	Sp. Gr.
0	1·000	20	1·1005	35	1·1820	50	1·2685
10	1·0490	25	1·1270	40	1·2105	55	1·2980
15	1·0740	30	1·1545	45	1·2390	60	1·3285

SODIUM ACETATE, $NaC_2H_3O_2$ + Aq at 17·5° C. (Gerlach).

Per cent. of Salt, 3 aq.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Salt. 3 aq.	Per cent. of Anhy.	Sp. Gr.
0	0	1·0000	30	18·090	1·0960
5	3·015	1·015	35	21·105	1·1130
10	6·030	1·031	40	24·120	1·1305
15	9·045	1·047	45	27·135	1·1485
20	12·060	1·063	50	30·150	1·1670
25	15·075	1·0795			

Acetic Acid, $C_2H_4O_2$ + Aq at 15° C. (Oudemann).

Acetic Acid, $C_2H_4O_2$, per cent.	Density.		Acetic Acid, $C_2H_4O_2$, per cent.	Density.	
	15° C.	40° C.		15° C.	40° C.
1	1·0007	0·9936	37	1·0492	1·0316
2	1·0022	0·9948	38	1·0502	1·0324
3	1·0037	0·9960	39	1·0513	1·0332
4	1·0052	0·9972	40	1·0523	1·0340
5	1·0067	0·9984	41	1·0533	1·0348
6	1·0083	0·9996	42	1·0543	1·0355
7	1·0098	1·0008	43	1·0552	1·0363
8	1·0113	1·0020	44	1·0562	1·0370
9	1·0127	1·0032	45	1·0571	1·0377
10	1·0142	1·0044	46	1·0580	1·0384
11	1·0157	1·0056	47	1·0589	1·0391
12	1·0171	1·0067	48	1·0598	1·0397
13	1·0185	1·0079	49	1·0607	1·0404
14	1·0200	1·0090	50	1·0615	1·0410
15	1·0214	1·0101	51	1·0623	1·0416
16	1·0228	1·0112	52	1·0631	1·0423
17	1·0242	1·0123	53	1·0638	1·0429
18	1·0256	1·0134	54	1·0646	1·0434
19	1·0270	1·0144	55	1·0653	1·0440
20	1·0284	1·0155	56	1·0660	1·0445
21	1·0298	1·0166	57	1·0666	1·0450
22	1·0311	1·0176	58	1·0673	1·0455
23	1·0324	1·0187	59	1·0679	1·0460
24	1·0337	1·0197	60	1·0685	1·0464
25	1·0350	1·0207	61	1·0691	1·0468
26	1·0363	1·0217	62	1·0697	1·0472
27	1·0375	1·0227	63	1·0702	1·0475
28	1·0388	1·0236	64	1·0707	1·0479
29	1·0400	1·0246	65	1·0712	1·0482
30	1·0412	1·0255	66	1·0717	1·0485
31	1·0424	1·0264	67	1·0721	1·0488
32	1·0436	1·0274	68	1·0725	1·0491
33	1·0447	1·0283	69	1·0729	1·0493
34	1·0459	1·0291	70	1·0733	1·0495
35	1·0470	1·0300	71	1·0737	1·0497
36	1·0481	1·0308	72	1·0740	1·0498

Acetic Acid—*continued.*

Acetic Acid, $C_2H_4O_2$, per cent.	Density.		Acetic Acid, $C_2H_4O_2$, per cent.	Density.	
	15° C.	40° C.		15° C.	40° C.
73	1·0742	1·0499	87	1·0731	1·0469
74	1·0744	1·0500	88	1·0726	1·0462
75	1·0746	1·0501	89	1·0720	1·0455
76	1·0747	1·0501	90	1·0713	1·0447
77	1·0748	1·0501	91	1·0705	1·0438
78	1·0748	1·0500	92	1·0696	1·0428
79	1·0748	1·0499	93	1·0686	1·0416
80	1·0748	1·0497	94	1·0674	1·0403
81	1·0747	1·0495	95	1·0660	1·0388
82	1·0746	1·0492	96	1·0644	1·0370
83	1·0744	1·0489	97	1·0625	1·0350
84	1·0742	1·0485	98	1·0604	1·0327
85	1·0739	1·0481	99	1·0580	1·0301
86	1·0736	1·0475	100	1·0553	1·0273

Aluminium Chloride, $AlCl_3$ + Aq at 15° C. (Gerlach).

Per cent. of $AlCl_3$.	Sp. Gr.	Per cent. of $AlCl_3$.	Sp. Gr.	Per cent. of $AlCl_3$.	Sp. Gr.	Per cent. of $AlCl_3$.	Sp. Gr.
1	1·0072	12	1·0890	23	1·1795	34	1·2808
2	1·0144	13	1·0968	24	1·1882	35	1·2905
3	1·0216	14	1·1047	25	1·1968	36	1·3007
4	1·0289	15	1·1125	26	1·2058	37	1·3109
5	1·0361	16	1·1207	27	1·2149	38	1·3211
6	1·0435	17	1·1290	28	1·2241	39	1·3313
7	1·0510	18	1·1372	29	1·2331	40	1·3415
8	1·0585	19	1·1455	30	1·2422	41	1·3522
9	1·0659	20	1·1537	31	1·2518	41·126	1·3536
10	1·0734	21	1·1632	32	1·2615		
11	1·0812	22	1·1709	33	1·2711		

Albumin + Aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
5	1·013	20	1·052	40	1·106
10	1·026	30	1·078	60	1·135

Alcohol. *Vide* Special Section X. p. 482.

Ammonia, NH_4OH + Aq at 15°C. (Lunge and Wiernik).

Sp. Gr.	Per cent. of NH_3.	1 l. contains g. NH_3.	Correction for ± 1° C.	Sp. Gr.	Per cent. of NH_3.	1 l. contains g. NH_3.	Correction for ± 1° C.
1·000	0·00	0·0	·00018	0·940	15·63	146·9	·00039
0·998	0·45	4·5	·00018	0·938	16·22	152·1	·00040
0·996	0·91	9·1	·00019	0·936	16·82	157·4	·00041
0·994	1·37	13·6	·00019	0·934	17·42	162·7	·00041
0·992	1·84	18·2	·00020	0·932	18·03	168·1	·00042
0·990	2·31	22·9	·00020	0·930	18·64	173·4	·00042
0·988	2·80	27·7	·00021	0·928	19·25	178·6	·00043
0·986	3·30	32·5	·00021	0·926	19·87	184·2	·00044
0·984	3·80	37·4	·00022	0·924	20·49	189·3	·00045
0·982	4·30	42·2	·00022	0·922	21·12	194·7	·00046
0·980	4·80	47·0	·00023	0·920	21·75	200·1	·00047
0·978	5·30	51·8	·00023	0·918	22·39	205·6	·00048
0·976	5·80	56·6	·00024	0·916	23·03	210·9	·00049
0·974	6·30	61·4	·00024	0·914	23·68	216·3	·00050
0·972	6·80	66·1	·00025	0·912	24·33	221·9	·00051
0·970	7·31	70·9	·00025	0·910	24·99	227·4	·00052
0·968	7·82	75·7	·00026	0·908	25·65	232·9	·00053
0·966	8·33	80·5	·00026	0·906	26·31	238·3	·00054
0·964	8·84	85·2	·00027	0·904	26·98	243·9	·00055
0·962	9·35	89·9	·00028	0·902	27·65	249·4	·00056
0·960	9·91	95·1	·00029	0·900	28·33	255·0	·00057
0·958	10·47	100·3	·00030	0·898	29·01	260·5	·00058
0·956	11·03	105·4	·00031	0·896	29·69	266·0	·00059
0·954	11·60	110·7	·00032	0·894	30·37	271·5	·00060
0·952	12·17	115·9	·00033	0·892	31·05	277·0	·00060
0·950	12·74	121·0	·00034	0·890	31·75	282·6	·00061
0·948	13·31	126·2	·00035	0·888	32·50	288·6	·00062
0·946	13·88	131·3	·00036	0·886	33·25	294·6	·00063
0·944	14·46	136·5	·00037	0·884	34·10	301·4	·00064
0·942	15·04	141·7	·00038	0·882	34·95	308·3	·00065

Ammonium Bromide, NH_4Br + Aq at 16° C.
(Hager, Comm. 1883).

Per cent. of NH_4Br.	Sp. Gr.	Per cent. of NH_4Br.	Sp. Gr.	Per cent. of NH_4Br.	Sp. Gr.	Per cent. of NH_4Br.	Sp. Gr.
2	1·0119	12	1·0735	22	1·1375	32	1·2098
3	1·0181	13	1·0798	23	1·1440	33	1·2180
4	1·0242	14	1·0862	24	1·1506	34	1·2260
5	1·0303	15	1·0926	25	1·1573	35	1·2342
6	1·0364	16	1·0988	26	1·1642	36	1·2425
7	1·0425	17	1·1051	27	1·1713	37	1·2509
8	1·0486	18	1·1115	28	1·1787	38	1·2594
9	1·0547	19	1·1181	29	1·1862	39	1·2679
10	1·0609	20	1·1246	30	1·1938	40	1·2765
11	1·0672	21	1·1310	31	1·2018	41	1·2850

Ammonium Chloride, NH_4Cl + Aq at 15° C. (Gerlach).

Per cent. of NH_4Cl.	Sp. Gr.	Per cent. of NH_4Cl.	Sp. Gr.	Per cent. of NH_4Cl.	Sp. Gr.	Per cent. of NH_4Cl.	Sp. Gr.
1	1·0032	9	1·0278	17	1·0509	25	1·0730
2	1·0063	10	1·0308	18	1·0537	26	1·0737
3	1·0095	11	1·0337	19	1·0565	26·297	1·0766
4	1·0126	12	1·0366	20	1·0593	27	*1·0768
5	1·0158	13	1·0395	21	1·0620	28	*1·0794
6	1·0188	14	1·0432	22	1·0648	29	*1·0820
7	1·0218	15	1·0452	23	1·0675	30	*1·0846
8	1·0248	16	1·0480	24	1·0703		

* Schiff's results at 19° C.

Ammonium Iodide $(NH_4)I$ + Aq at 18° C. (Kohlrausch).

Per cent. of NH_4I.	Sp. Gr.	Per cent. of NH_4I.	Sp. Gr.	Per cent. of NH_4I.	Sp. Gr.
10	1·0652	30	1·226	50	1·4415
20	1·1397	40	1·326		

Arseniates.

Na_3AsO_4 + Aq at 17° C. (Schiff).

Per cent. of Na_3AsO_4, 12aq.	Sp. Gr.	Per cent. of Na_3AsO_4, 12aq.	Sp. Gr.	Per cent. of Na_3AsO_4, 12aq.	Sp. Gr.	Per cent. of Na_3AsO_4, 12aq.	Sp. Gr.
1	1·0053	7	1·0380	13	1·0716	19	1·1061
2	1·0107	8	1·0435	14	1·0773	20	1·1121
3	1·0161	9	1·0490	15	1·0830	21	1·1179
4	1·0215	10	1·0547	16	1·0887	22	1·1238
5	1·0270	11	1·0603	17	1·0945		
6	1·0325	12	1·0659	18	1·1003		

Na_2HAsO_4 + Aq at 14° C. (Schiff; Gerlach).

Per cent. of Na_2HAsO_4, 12aq.	Sp. Gr.	Per cent. of Na_2HAsO_4, 12aq.	Sp. Gr.	Per cent. of Na_2HAsO_4, 12aq.	Sp. Gr.	Per cent. of Na_2HAsO_4, 12aq.	Sp. Gr.
1	1·0042	11	1·0479	21	1·0953	31	1·1463
2	1·0084	12	1·0525	22	1·1003	32	1·1516
3	1·0126	13	1·0571	23	1·1052	33	1·1569
4	1·0168	14	1·0618	24	1·1103	34	1·1623
5	1·0212	15	1·0665	25	1·1153	35	1·1677
6	1·0256	16	1·0712	26	1·1204	36	1·1731
7	1·0300	17	1·0759	27	1·1255	37	1·1786
8	1·0344	18	1·0807	28	1·1306	38	1·1841
9	1·0389	19	1·0855	29	1·1358	39	1·1896
10	1·0434	20	1·0904	30	1·1410	40	1·1952

Arsenic Acid, H_3AsO_4 + Aq at 15° C. (Kopp; Gerlach).

a = Sp. Gr. if per cent. is As_2O_5.
b = Sp. Gr. if per cent. is H_3AsO_4.

Per cent.	*a*	*b*	Per cent.	*a*	*b*	Per cent.	*a*	*b*
1	1·008	1·006	32	1·325	1·248	63	1·940	1·643
2	1·016	1·013	33	1·339	1·257	64	1·970	1·659
3	1·023	1·019	34	1·352	1·267	65	2·000	1·675
4	1·031	1·026	35	1·366	1·277	66	2·030	1·693
5	1·039	1·032	36	1·381	1·288	67	2·060	1·712
6	1·048	1·039	37	1·396	1·299	68	2·090	1·730
7	1·057	1·046	38	1·411	1·309	69	2·120	1·749
8	1·065	1·052	39	1·426	1·320	70	2·150	1·767
9	1·074	1·059	40	1·441	1·331	71	..	1·788
10	1·083	1·066	41	1·458	1·342	72	..	1·809
11	1·092	1·073	42	1·475	1·353	73	..	1·830
12	1·102	1·081	43	1·492	1·366	74	..	1·851
13	1·111	1·088	44	1·509	1·376	75	..	1·872
14	1·121	1·096	45	1·526	1·387	76	..	1·897
15	1·130	1·103	46	1·545	1·400	77	..	1·921
16	1·140	1·111	47	1·564	1·412	78	..	1·946
17	1·150	1·119	48	1·582	1·425	79	..	1·970
18	1·160	1·126	49	1·601	1·437	80	..	1·995
19	1·170	1·134	50	1·620	1·450	81	..	2·020
20	1·180	1·142	51	1·642	1·464	82	..	2·045
21	1·191	1·150	52	1·663	1·478	83	..	2·070
22	1·203	1·158	53	1·685	1·491	84	..	2·095
23	1·214	1·167	54	1·706	1·505	85	..	2·120
24	1·226	1·175	55	1·728	1·519	86	..	2·149
25	1·237	1·183	56	1·752	1·534	87	..	2·178
26	1·249	1·192	57	1·777	1·549	88	..	2·207
27	1·261	1·201	58	1·801	1·564	89	..	2·236
28	1·274	1·210	59	1·825	1·579	90	..	2·265
29	1·286	1·219	60	1·850	1·594	91	..	2·295
30	1·298	1·228	61	1·880	1·610			
31	1·312	1·238	62	1·910	1·626			

Barium Bromide, $BaBr_2$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $BaBr_2$.	Sp. Gr.	Per cent. of $BaBr_2$.	Sp. Gr.	Per cent. of $BaBr_2$.	Sp. Gr.	Per cent. of $BaBr_2$.	Sp. Gr.	Per cent. of $BaBr_2$.	Sp. Gr.
5	1·045	15	1·144	25	1·262	35	1·405	45	1·580
10	1·092	20	1·201	30	1·329	40	1·485	50	1·685

Barium Chloride, $BaCl_2$ + Aq at 15° C. (Gerlach).

Per cent. of $BaCl_2$.	Sp. Gr.	Per cent. of $BaCl_2$.	Sp. Gr.	Per cent. of $BaCl_2$.	Sp. Gr.	Per cent. of $BaCl_2$.	Sp. Gr.
1	1·0092	7	1·0655	13	1·1271	19	1·1946
2	1·0183	8	1·0754	14	1·1378	20	1·2068
3	1·0275	9	1·0852	15	1·1485	21	1·2189
4	1·0367	10	1·0951	16	1·1600	22	1·2317
5	1·0458	11	1·1058	17	1·1715	23	1·2446
6	1·0557	12	1·1164	18	1·1830	24	1·2574
						25	1·2702

Barium Hydroxide, $Ba(OH)_2$ + Aq (Dalton).

Per cent. of BaO.	Sp. Gr.	Per cent. of BaO.	Sp. Gr.	Per cent. of BaO.	Sp. Gr.	Per cent. of BaO.	Sp. Gr.
0·9	1·01	1·8	1·02	2·6	1·03	19	1·3
						30	1·6

Barium Iodide, BaI_2 + Aq at 19·5° (Kremers; Gerlach).

Per cent. of BaI.	Sp. Gr.	Per cent. of BaI.	Sp. Gr.	Per cent. of BaI.	Sp. Gr.	Per cent. of BaI.	Sp. Gr.
5	1·045	20	1·201	40	1·495	60	1·970
10	1·091	30	1·333	50	1·704		

Boracic Acid, H_3BO_3 + Aq at 15° C. (Gerlach).

Per cent. of H_3BO_3.	Sp. Gr.	Per cent. of H_3BO_3.	Sp. Gr.	Per cent. of H_3BO_3.	Sp. Gr.	Per cent. of H_3BO_3.	Sp. Gr.
1	1·0034	2	1·0069	3	1·0106	4	1·0147
						sat. sol.	1·015

Bromates.

POTASSIUM BROMATE, $KBrO_3$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $KBrO_3$.	Sp.Gr.	Per cent. of $KBrO_3$.	Sp.Gr.	Per cent. of $KBrO_3$.	Sp.Gr.	Per cent. of $KBrO_3$.	Sp.Gr.	Per cent. of $KBrO_3$.	Sp.Gr.
2	1·016	4	1·031	6	1·046	8	1·062	10	1·079

SODIUM BROMATE, $NaBrO_3$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $NaBrO_3$.	Sp. Gr.	Per cent. of $NaBrO_3$.	Sp. Gr.	Per cent. of $NaBrO_3$.	Sp. Gr.
5	1·041	15	1·129	25	1·231
10	1·083	20	1·178	30	1·289

Bromine, Br + Aq (Slessors).

Per cent. of Br.	Sp. Gr.	Per cent. of Br.	Sp. Gr.	Per cent. of Br.	Sp. Gr.	Per cent. of Br.	Sp. Gr.
1·022	1·0090	1·205	1·0099	1·874–1·906	1·0149	2·089–2·155	1·0181
1·067	1·0093	1·231	1·0122	1·952–2·009	1·0158	3·102–3·169 (saturated)	1·0237

Bromhydric Acid, HBr + Aq (Topsöe; cal. Gerlach).

Per cent. of HBr.	Sp. Gr. $\frac{14}{14}$.	Per cent. of HBr.	Sp. Gr. $\frac{14}{14}$.	Per cent. of HBr.	Sp. Gr. $\frac{14}{14}$.	Per cent. of HBr.	Sp. Gr. $\frac{14}{14}$.
1	1·007	13	1·097	25	1·206	37	1·338
2	1·014	14	1·106	26	1·215	38	1·351
3	1·021	15	1·114	27	1·225	39	1·363
4	1·028	16	1·122	28	1·235	40	1·376
5	1·035	17	1·131	29	1·246	41	1·389
6	1·043	18	1·140	30	1·257	42	1·403
7	1·050	19	1·149	31	1·268	43	1·417
8	1·058	20	1·158	32	1·279	44	1·431
9	1·065	21	1·167	33	1·290	45	1·445
10	1·073	22	1·176	34	1·302	46	1·459
11	1·081	23	1·186	35	1·314	47	1·473
12	1·089	24	1·196	36	1·326	48	1·487
						49	1·502

Cadmium Bromide, $CdBr_2$ + Aq at 19·5° C.

Per cent. of $CdBr_2$.	Sp. Gr.	Per cent. of $CdBr_2$.	Sp. Gr.	Per cent. of $CdBr_2$.	Sp. Gr.	Per cent. of $CdBr_2$.	Sp. Gr.
5	1·043	10	1·090	20	1·199	30	1·326
						40	1·481
						50	1·680

Cadmium Chloride, $CdCl_2$ + Aq at 19·5° C.

Per cent. of $CdCl_2$.	Sp. Gr.	Per cent. of $CdCl_2$.	Sp. Gr.	Per cent. of $CdCl_2$.	Sp. Gr.
5	1·015	15	1·140	25	1·256
10	1·089	20	1·195	30	1·321

Cadmium Iodide, CdI_2 + Aq at 19·5° C. (Kremers).

Per cent. of CdI_2.	Sp. Gr.	Per cent. of CdI_2.	Sp. Gr.	Per cent. of CdI_2.	Sp. Gr.
5	1·044	20	1·194	40	1·476
10	1·088	30	1·319	50	1·680

Calcium Bromide, $CaBr_2$ + Aq at 19·5° C.

Per cent. of $CaBr_2$.	Sp. Gr.	Per cent. of $CaBr_2$.	Sp. Gr.	Per cent. of $CaBr_2$.	Sp. Gr.	Per cent. of $CaBr_2$.	Sp. Gr.
5	1·044	20	1·194	35	1·385	50	1·641
10	1·089	25	1·252	40	1·461		
15	1·139	30	1·315	45	1·549		

Calcium Chloride, $CaCl_2$ + Aq. G = Gerlach's results for $CaCl_2$ at 15°. S = Schiff's results for $CaCl_2$,6aq at 18·3°.

Per cent.	Sp. Gr. (G).	Sp. Gr. (S).	Per cent.	Sp. Gr. (G).	Sp. Gr. (S).	Per cent.	Sp. Gr. (S).
1	1·0085	1·0039	25	1·2336	1·1062	49	1·2212
2	1·0170	1·0079	26	1·2445	1·1107	50	1·2262
3	1·0255	1·0119	27	1·2553	1·1153	51	1·2312
4	1·0341	1·0159	28	1·2662	1·1199	52	1·2363
5	1·0426	1·0200	29	1·2770	1·1246	53	1·2414
6	1·0515	1·0241	30	1·2879	1·1292	54	1·2465
7	1·0603	1·0282	31	1·2992	1·1339	55	1·2516
8	1·0692	1·0323	32	1·3104	1·1386	56	1·2567
9	1·0781	1·0365	33	1·3217	1·1433	57	1·2618
10	1·0869	1·0407	34	1·3360	1·1480	58	1·2669
11	1·0963	1·0449	35	1·3443	1·1527	59	1·2721
12	1·1056	1·0491	36	1·3561	1·1575	60	1·2773
13	1·1149	1·0534	37	1·3679	1·1622	61	1·2825
14	1·1243	1·0577	38	1·3797	1·1671	62	1·2877
15	1·1336	1·0619	39	1·3915	1·1719	63	1·2929
16	1·1433	1·0663	40	1·4033	1·1768	64	1·2981
17	1·1530	1·0706	41	..	1·1816	65	1·3034
18	1·1628	1·0750	42	..	1·1865	66	1·3087
19	1·1725	1·0794	43	..	1·1914	67	1·3140
20	1·1822	1·0838	44	..	1·1963	68	1·3193
21	1·1925	1·0882	45	..	1·2012	69	1·3246
22	1·2028	1·0927	46	..	1·2062	70	1·3300
23	1·2131	1·0972	47	..	1·2112		
24	1·2234	1·1017	48	..	1·2162		

Calcium Iodide, $CaI_2 + Aq$ at 19·5° C. (Kremers; Gerlach).

Per cent. of CaI_2.	Sp. Gr.	Per cent. of CaI_2.	Sp. Gr.	Per cent. of CaI_2.	Sp. Gr.	Per cent. of CaI_2.	Sp. Gr.
5	1·044	20	1·198	35	1·398	50	1·665
10	1·09	25	1·26	40	1·477	55	1·78
15	1·14	30	1·321	45	1·567	60	1·91

Calcium Nitrate, $Ca(NO_3)_2 + Aq$ at 17·5° (Gerlach).

Per cent. of $Ca(NO_3)_2$*	Sp. Gr.	Per cent. of $Ca(NO_3)_2$	Sp. Gr.	Per cent. of $Ca(NO_3)_2$	Sp. Gr.	Per cent. of $Ca(NO_3)_2$	Sp. Gr.
0	1·000	16·4	1·124	32·8	1·272	49·2	1·445
8·2	1·059	24·6	1·195	41	1·355		

* Multiply by 1·22 to obtain per cent. of $Ca(NO_3)_2$ 2 aq.

Calcium Oxide, CaO in aqueous solutions of sugar (lime in syrup).

Sugar in 100 parts of Water.	Density of Syrup.	Density after saturation with Lime.	100 Parts of the Residue dried at 120° C. contain	
			Lime.	Sugar.
40	1·122	1·179	21	79
35	1·110	1·166	20·5	79·5
30	1·096	1·148	20·1	79·9
25	1·082	1·128	19·8	80·2
20	1·068	1·104	18·8	81·2
15	1·052	1·080	18·5	81·5
10	1·036	1·053	18·1	81·9
5	1·018	1·026	15·3	84·7

Calcium Oxide in "Milk of Lime" (Lunge and Blattner).

Beaumé.	Wt. of 1 l. "milk" in g.	g CaO in 1 l.	Per cent. of CaO.	Beaumé.	Wt. of 1 l. "milk" in g.	g CaO in 1 l.	Per cent. of CaO.
1	1007	7·5	·745	16	1125	159	14·13
2	1014	16·5	1·64	17	1134	170	15·00
3	1022	26	2·54	18	1142	181	15·85
4	1029	36	3·54	19	1152	193	16·75
5	1037	46	4·43	20	1162	206	17·72
6	1045	56	5·36	21	1171	218	18·61
7	1052	65	6·18	22	1180	229	19·40
8	1060	75	7·08	23	1190	242	20·34
9	1067	84	7·87	24	1200	255	21·25
10	1075	94	8·74	25	1210	268	22·15
11	1083	104	9·60	26	1220	281	23·03
12	1091	115	10·54	27	1231	295	23·96
13	1100	126	11·45	28	1241	309	24·90
14	1108	137	12·35	29	1252	324	25·87
15	1116	148	13·26	30	1263	339	26·84

Carbonates.

"COMMERCIAL" AMMONIUM CARBONATE AT 15° C. (Lunge).

Deg. Twaddell.	Sp. Gr.	Per cent.	Change of Sp. Gr. for ± 1° C.	Deg. Twaddell.	Sp. Gr.	Per cent.	Change of Sp. Gr. for ± 1° C.
1	1·005	1·66	·0002	16	1·080	23·78	·0006
2	1·010	3·18	·0002	17	1·085	25·31	·0007
3	1·015	4·60	·0003	18	1·090	26·82	·0007
4	1·020	6·04	·0003	19	1·095	28·33	·0007
5	1·025	7·49	·0003	20	1·100	29·93	·0007
6	1·030	8·93	·0004	21	1·105	31·77	·0007
7	1·035	10·35	·0004	22	1·110	33·45	·0007
8	1·040	11·86	·0004	23	1·115	35·08	·0007
9	1·045	13·36	·0005	24	1·120	36·88	·0007
10	1·050	14·83	·0005	25	1·125	38·71	·0007
11	1·055	16·16	·0005	26	1·130	40·34	·0007
12	1·060	17·70	·0005	27	1·135	42·20	·0007
13	1·065	19·18	·0005	28	1·140	44·29	·0007
14	1·070	20·70	·0005	29	1·1414	44·90	·0007
15	1·075	22·25	·0006				

Carbonates—*continued.*

POTASSIUM CARBONATE, K_2CO_3 + Aq at $\frac{15}{4}$ (Gerlach).

Sp. Gr. $\frac{15}{4}$	Per cent. by weight. K_2CO_3.	Kilogr. per cubic metre. K_2CO_3.	lbs. per cubic foot. K_2CO_3.	Sp. Gr. $\frac{15}{4}$	Per cent. by weight. K_2CO_3.	Kilogr. per cubic metre. K_2CO_3.	lbs. per cubic foot. K_2CO_3.
1·005	·54	5·4	0·34	1·145	15·39	176·2	10·99
1·010	1·08	10·9	0·68	1·150	15·90	182·8	11·40
1·015	1·62	16·4	1·02	1·155	16·38	189·2	11·80
1·020	2·16	22·0	1·37	1·160	16·86	195·6	12·20
1·025	2·70	27·7	1·73	1·165	17·34	202·0	12·59
1·030	3·24	33·4	2·08	1·170	17·82	208·5	13·00
1·035	3·78	39·1	2·43	1·175	18·30	215·0	13·40
1·040	4·32	44·9	2·80	1·180	18·78	221·6	13·82
1·045	4·86	50·8	3·17	1·185	19·26	228·2	14·23
1·050	5·40	56·7	3·53	1·190	19·74	234·9	14·65
1·055	5·94	62·7	3·90	1·195	20·22	241·7	15·07
1·060	6·48	68·7	4·28	1·200	20·70	248·4	15·49
1·065	7·02	74·8	4·66	1·205	21·17	255·2	15·91
1·070	7·56	80·9	5·04	1·210	21·65	262·0	16·33
1·075	8·10	87·1	5·43	1·215	22·12	268·8	16·76
1·080	8·64	93·3	5·82	1·220	22·60	275·7	17·19
1·085	9·18	99·6	6·21	1·225	23·07	282·6	17·62
1·090	9·72	105·9	6·60	1·230	23·55	289·6	18·05
1·095	10·26	108·4	6·51	1·235	24·02	296·7	18·50
1·100	10·80	118·8	7·41	1·240	24·50	303·8	18·94
1·105	11·31	125·0	7·79	1·245	24·97	310·9	19·38
1·110	11·82	131·2	8·18	1·250	25·45	318·1	19·83
1·115	12·33	137·5	8·57	1·255	25·89	325·0	20·26
1·120	12·84	143·8	8·97	1·260	26·34	331·9	20·70
1·125	13·35	150·2	9·37	1·265	26·78	338·8	21·12
1·130	13·86	156·6	9·76	1·270	27·23	345·8	21·56
1·135	14·37	163·1	10·17	1·275	27·68	352·8	22·00
1·140	14·88	169·6	10·57	1·280	28·12	359·9	22·44

POTASSIUM CARBONATE—*continued.*

Sp. Gr. $\frac{15}{4}$	Per cent. by Weight. K_2CO_3.	Kilogr. per cubic metre. K_2CO_3.	Lbs. per cubic foot. K_2CO_3.	Sp. Gr. $\frac{15}{4}$	Per cent. by Weight. K_2CO_3.	Kilogr. per cubic metre. K_2CO_3.	Lbs. per cubic foot. K_2CO_3.
1·285	28·57	367·1	22·89	1·430	40·96	585·7	36·51
1·290	29·02	374·3	23·34	1·435	41·37	593·6	37·01
1·295	29·46	381·5	23·79	1·440	41·78	601·6	37·51
1·300	29·91	388·8	24·24	1·445	42·19	609·6	38·01
1·305	30·34	395·9	24·68	1·450	42·60	617·7	38·51
1·310	30·77	403·1	25·13	1·455	43·00	625·6	39·01
1·315	31·21	410·3	25·58	1·460	43·40	633·6	39·51
1·320	31·64	417·6	26·04	1·465	43·80	641·6	40·01
1·325	32·08	425·0	26·50	1·470	44·20	649·7	40·51
1·330	32·51	432·4	26·96	1·475	44·60	657·8	41·01
1·335	32·94	439·8	27·42	1·480	45·00	666·0	41·52
1·340	33·38	447·3	27·89	1·485	45·40	674·2	42·03
1·345	33·81	454·8	28·36	1·490	45·80	682·4	42·55
1·350	34·25	462·4	28·83	1·495	46·20	690·7	43·06
1·355	34·67	469·9	29·30	1·500	46·60	699·0	43·58
1·360	35·10	477·4	29·77	1·505	46·98	707·1	44·09
1·365	35·52	484·9	30·23	1·510	47·37	715·3	44·61
1·370	35·95	492·5	30·71	1·515	47·75	723·5	45·11
1·375	36·37	500·1	31·18	1·520	48·14	731·7	45·62
1·380	36·80	507·8	31·66	1·525	48·52	740·0	46·14
1·385	37·22	515·6	32·15	1·530	48·91	748·3	46·66
1·390	37·65	523·3	32·63	1·535	49·29	756·7	47·18
1·395	38·07	531·7	33·11	1·540	49·68	765·1	47·70
1·400	38·50	539·0	33·60	1·545	50·06	773·5	48·22
1·405	38·91	546·7	34·09	1·550	50·45	782·0	48·76
1·410	39·32	554·4	34·57	1·555	50·83	790·5	49·29
1·415	39·73	562·2	35·05	1·560	51·22	799·0	49·82
1·420	40·14	570·0	35·54	1·565	51·61	807·7	50·36
1·425	40·55	577·8	36·02	1·570	52·00	816·4	50·90

Carbonates—*continued.*

SODIUM CARBONATE, $Na_2CO_3 + Aq$ at 15° C. (Lunge).

Sp. Gr.	Per cent.		Lbs. per cubic foot.		
	Na_2O.	Na_2Co_3.	Na_2O.	Na_2CO_3.	48 per cent. Ash.*
1·005	0·28	0·47	0·172	0·294	0·358
1·010	0·56	0·95	0·350	0·598	0·728
1·015	0·84	1·42	0·525	0·898	1·094
1·020	1·11	1·90	0·707	1·209	1·473
1·025	1·39	2·38	0·889	1·521	1·853
1·030	1·67	2·85	1·070	1·830	2·230
1·035	1·95	3·33	1·257	2·149	2·618
1·040	2·22	3 80	1·441	2·464	3·002
1·045	2·50	4·28	1·631	2·788	3·397
1·050	2·78	4·76	1·852	3·116	3·797
1·055	3·06	5·23	2·012	3·440	4·192
1·060	3·34	5·71	2·206	3·772	4·596
1·065	3·61	6·17	2·396	4·097	4·992
1·070	3·88	6·64	2·591	4·430	5·397
1·075	4·16	7·10	2·783	4·759	5·799
1·080	4·42	7·57	2·981	5·098	6·211
1·085	4·70	8·04	3·181	5·439	6·627
1·090	4·97	8·51	3·382	5·783	7·046
1·095	5·24	8·97	3·582	6·125	7·462
1·100	5·52	9·43	3·783	6·468	7·880
1·105	5·79	9·90	3·989	6·821	8·311
1·110	6·06	10·37	4·197	7·177	8·745
1·115	6·33	10·83	4·403	7·529	9·174
1·120	6·61	11·30	4·615	7·891	9·613
1·125	6·88	11·76	4·825	8·249	10·050
1·130	7·15	12·23	5·040	8·617	10·500
1·135	7·42	12·70	5·256	8·988	10·951
1·140	7·70	13·16	5·465	9·354	11·396
1·145	7·97	13·63	5·691	9·731	11·857
1·150	8·24	14·09	5·908	10·103	12·310

* Equivalent to 31.

Carbonates—*continued.*

SODIUM CARBONATE, $Na_2CO_3 + Aq$ at 30° C. (Lunge).

Note.—The stronger liquors cannot exist at 15° C.

Sp. Gr.	Per cent.		Lbs. per cubic foot.		
	Na_2O.	Na_2CO_3.	Na_2O.	Na CO_3.	48 per cent. Ash.
1·140	7·97	13·62	5·662	9·681	11·80
1·145	8·21	14·04	5·86	10·02	12·12
1·150	8·46	14·47	6·06	10·37	12·64
1·155	8·71	14·89	6·27	10·72	13·06
1·160	8·96	15·32	6·48	11·08	13·50
1·165	9·21	15·74	6·69	11·43	13·93
1·170	9·46	16·18	6·91	11·81	14·39
1·175	9·71	16·60	7·11	12·16	14·82
1·180	9·96	17·04	7·33	12·53	15·27
1·185	10·21	17·46	7·54	12·90	15·72
1·190	10·46	17·89	7·76	13·27	16·17
1·195	10·71	18·32	7·98	13·65	16·63
1·200	10·97	18·75	8·21	14·03	17·10
1·205	11·22	19·18	8·42	14·40	17·55
1·210	11·47	19·61	8·65	14·79	18·03
1·215	11·72	20·04	8·88	15·18	18·50
1·220	11·97	20·47	9·11	15·57	18·97
1·225	12·23	20·90	9·34	15·96	19·45
1·230	12·48	21·33	9·56	16·35	19·92
1·235	12·73	21·77	9·80	16·76	20·42
1·240	12·98	22·20	10·03	17·16	20·91
1·245	13·24	22·63	10·27	17·57	21·41
1·250	13·49	23·07	10·52	17·98	21·91
1·255	13·74	23·50	10·76	18·39	22·41
1·260	14·00	23·93	11·00	18·80	22·91
1·265	14·24	24·35	11·25	19·20	23·40
1·270	14·49	24·77	11·47	19·61	23·90
1·275	14·73	25·19	11·72	20·03	24·41
1·280	14·98	25·61	11·95	20·44	24·91
1·285	15·22	26·03	12·20	20·86	25·42
1·290	15·47	26·45	12·45	21·28	25·93
1·295	15·72	26·87	12·69	21·69	26·43
1·300	15·96	27·29	12·94	22·12	26·95
1·305	16·20	27·71	13·18	22·54	27·47
1·310	16·45	28·13	13·44	22·97	27·99

Chlorates.

POTASSIUM CHLORATE, $KClO_3$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $KClO_3$.	Sp. Gr.	Per cent. of $KClO_3$.	Sp. Gr.	Per cent. of $KClO_3$.	Sp. Gr.
2	1·014	6	1·039	10	1·066
4	1·026	8	1·052		

SODIUM CHLORATE, $NaClO_3$ + Aq at 19·5° C. (Kremers; Gerlach).

Per ecnt. of $NaClO_3$.	Sp. Gr.	Per cent. of $NaClO_3$.	Sp. Gr.	Per cent. of $NaClO_3$.	Sp. Gr.
5	1·035	20	1·147	35	1·282
10	1·070	25	1·190	40	1·331
15	1·108	30	1·235		

Chlorhydric Acid, HCl + Aq at $\frac{15}{4}$ (Lunge and Marchlewski).

Sp. Gr. $\frac{15}{4}$ *in vacuo.*	100 parts by wt. contain parts by wt. of			gHCl per l.	Lbs. HCl per cubic foot.
	HCl.	Acid of Sp. Gr. 1·1425 = 28·5° Tw.	Acid of Sp. Gr. 1·152 = 30·4° Tw.		
1·000	0·16	0·57	0·53	1·6	0·10
1·005	1·15	4·08	3·84	12	0·75
1·010	2·14	7·60	7·14	22	1·37
1·015	3·12	11·80	10·41	32	1·99
1·020	4·13	14·67	13·79	42	2·62
1·025	5·15	18·30	17·19	53	3·30
1·030	6·15	21·85	20·53	64	3·99

Chlorhydric Acid—*continued.*

Sp. Gr. $\frac{15}{4}$. *in vacuo.*	100 parts by wt. contain parts by wt. of			gHCl per l.	Lbs. HCl per cubic foot.
	HCl.	Acid of Sp. Gr. 1·1425 = 28·5° Tw.	Acid of Sp. Gr. 1·152 = 30·4° Tw.		
1·035	7·15	25·40	23·87	74	4·61
1·040	8·16	28·99	27·24	85	5·30
1·045	9·16	32·55	30·58	96	5·98
1·050	10·17	36·14	33·95	107	6·67
1·055	11·18	39·73	37·33	118	7·35
1·060	12·19	43·32	40·70	129	8·04
1·065	13·19	46·87	44·04	141	8·79
1·070	14·17	50·35	47·31	152	9·48
1·075	15·16	53·87	50·62	163	10·16
1·080	16·15	57·39	53·92	174	10·85
1·085	17·13	60·87	57·19	186	11·59
1·090	18·11	64·35	60·47	197	12·28
1·095	19·06	67·73	63·64	209	13·03
1·100	20·01	71·11	66·81	220	13·71
1·105	20·97	74·52	70·01	232	14·46
1·110	21·92	77·89	73·19	243	15·15
1·115	22·86	81·23	76·32	255	15·90
1·120	23·82	84·64	79·53	267	16·65
1·125	24·78	88·06	82·74	278	17·33
1·130	25·75	91·50	85·97	291	18·14
1·135	26·70	94·88	89·15	303	18·89
1·140	27·66	98·29	92·35	315	19·64
1·145	28·61	101·67	95·52	328	20·45
1·150	29·57	105·08	98·73	340	21·20
1·155	30·55	108·58	102·00	353	22·01
1·160	31·52	112·01	105·24	366	22·82
1·165	32·49	115·46	108·48	379	23·63
1·170	33·46	118·91	111·71	392	24·44
1·175	34·42	122·32	114·92	404	25·19
1·180	35·59	125·76	118·16	418	26·06
1·185	36·31	129·03	121·23	430	26·81
1·190	37·23	132·30	124·30	443	27·62
1·195	38·16	135·61	127·41	456	28·43
1·200	39·11	138·98	130·58	469	29·24

Chloric Acid, $HClO_3$ + Aq at 14° (Kämmerer).

Per cent. of Cl_2O_5.	Per cent. of $HClO_3$.	Sp. Gr.
16·98	19·00	1·128
21·29	23·823	1·161
35·73	39·982	1·262

Chromates.

POTASSIUM CHROMATE, K_2CrO_4 + Aq at 19·5° C.; (Kremers, Schiff; cal. Gerlach).

Per cent. of K_2CrO_4.	Sp. Gr.	Per cent. of K_2CrO_4.	Sp. Gr.	Per cent. of K_2CrO_4.	Sp. Gr.	Per cent. of K_2CrO_4.	Sp. Gr.
1	1·0080	11	1·0925	21	1·1864	31	1·2921
2	1·0161	12	1·1014	22	1·1964	32	1·3035
3	1·0243	13	1·1104	23	1·2066	33	1·3151
4	1·0325	14	1·1195	24	1·2169	34	1·3268
5	1·0408	15	1·1287	25	1·2274	35	1·3386
6	1·0492	16	1·1380	26	1·2379	36	1·3505
7	1·0576	17	1·1474	27	1·2485	37	1·3625
8	1·0663	18	1·1570	28	1·2592	38	1·3746
9	1·0750	19	1·1667	29	1·2700	39	1·3868
10	1·0837	20	1·1765	30	1·2808	40	1·3991

POTASSIUM DI-CHROMATE, $K_2Cr_2O_7$ + Aq at 19·5° C. (Kremers; cal. Gerlach).

Per cent. of $K_2Cr_2O_7$.	Sp. Gr.	Per cent. of $K_2Cr_2O_7$.	Sp. Gr.	Per cent. of $K_2Cr_2O_7$.	Sp. Gr.	Per cent. of $K_2Cr_2O_7$.	Sp. Gr.
1	1·007	5	1·037	9	1·065	13	1·097
2	1·015	6	1·043	10	1·073	14	1·102
3	1·022	7	1·050	11	1·080	15	1·110
4	1·030	8	1·056	12	1·085		

Chromates—*continued.*

SODIUM DI-CHROMATE, $Na_2Cr_2O_7$ + Aq (Stanley).

Per cent. of $Na_2Cr_2O_7$.	Sp. Gr.	Per cent. of $Na_2Cr_2O_7$.	Sp. Gr.	Per cent. of $Na_2Cr_2O_7$.	Sp. Gr.	Per cent. of $Na_2Cr_2O_7$.	Sp. Gr.
1	1·007	20	1·141	35	1·245	50	1·343
5	1·035	25	1·171	40	1·280		
10	1·071	30	1·208	45	1·313		

Chromic Acid, H_2CrO_4 + Aq at $\frac{17\cdot5}{17\cdot5}$° and $\frac{15}{4}$° (Zettnow; Mendelejeff).

Per cent. of CrO_3.	Sp. Gr. $\frac{17\cdot5}{17\cdot5}$.	Sp. Gr. $\frac{15}{4}$.	Per cent. of CrO_3.	Sp. Gr. $\frac{17\cdot5}{17\cdot5}$.	Sp. Gr. $\frac{15}{4}$.	Per cent. of CrO_3.	Sp. Gr. $\frac{17\cdot5}{17\cdot5}$.	Sp. Gr. $\frac{15}{4}$.
0	1·000	0·997	25	1·208	1·215	50	1·512	1·510
5	1·037	1·036	30	1·258	1·268	55	1·587	1·579
10	1·076	1·076	35	1·312	1·324	60	1·665	—
15	1·118	1·119	40	1·373	1·383			
20	1·162	1·166	45	1·440	1·445			

Citric Acid, $C_6H_8O_7$ + Aq at 15° C. (Gerlach).

Per cent. of $C_6H_8O_7$, aq.	Sp. Gr.	Per cent. of $C_6H_8O_7$, aq.	Sp. Gr.	Per cent. of $C_6H_8O_7$, aq.	Sp. Gr.	Per cent. of $C_6H_8O_7$, aq.	Sp. Gr.
2	1·0074	20	1·0805	38	1·1612	56	1·2514
4	1·0149	22	1·0889	40	1·1709	58	1·2627
6	1·0227	24	1·0972	42	1·1814	60	1·2738
8	1·0309	26	1·1060	44	1·1899	62	1·2849
10	1·0392	28	1·1152	46	1·1998	64	1·2960
12	1·0470	30	1·1244	48	1·2103	66	1·3071
14	1·0549	32	1·1333	50	1·2204	66·1 satd.	1·3076
16	1·0632	34	1·1422	52	1·2307		
18	1·0718	36	1·1515	54	1·2410		

Cobalt Chloride, $CoCl_2$ + Aq at 17·5° C. (Franz).

Per cent. of $CoCl_2$.	Sp. Gr.	Per cent. of $CoCl_2$.	Sp. Gr.	Per cent. of $CoCl_2$.	Sp. Gr.
5	1·0496	15	1·1579	25	1·3002
10	1·0997	20	1·2245	satd.	1·3613

Copper Chloride, $CuCl_2$ + Aq at 17·5° C. (Franz).

Per cent. of $CuCl_2$.	Sp. Gr.	Per cent. of $CuCl_2$.	Sp. Gr.	Per cent. of $CuCl_2$.	Sp. Gr.	Per cent. of $CuCl_2$.	Sp. Gr.
5	1·0455	15	1·1565	25	1·2918	35	1·4447
10	1·0920	20	1·2223	30	1·3618	40	1·5284

Cyanhydric Acid, HCN + Aq (Ure).

Per cent. of HCN.	Sp. Gr.	Per cent. of HCN.	Sp. Gr.	Per cent. of HCN.	Sp. Gr.	Per cent. of HCN.	Sp. Gr.
1·60	0·9979	2·5	1·9967	4·6	1·9930	8·0	1·9840
1·68	1·9978	2·7	1·9964	5·0	1·9923	9·1	1·9815
1·77	1·9975	3·0	1·9958	5·3	1·9914	10·6	1·9768
2·0	1·9974	3·2	1·9952	5·8	1·9900	16·0	1·9570
2·1	1·9973	3·6	1·9945	6·4	1·9890		
2·3	1·9970	4·0	1·9940	7·3	1·9870		

Cyanides.

FERRICYANIDE AND FERROCYANIDE.

POTASSIUM CYANIDE, KCN + Aq at 15° C. (Kohlrausch).

Per cent. of KCN.	Sp. Gr.	Per cent. of KCN.	Sp. Gr.
3·25	1·0154	6·5	1·0316

Cyanides—*continued.*

Potassium Ferricyanide, $K_3Fe(CN)_6 + Aq$ at 13° C. (Schiff).

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·0051	9	1·0482	17	1·0952	25	1·1462
2	1·0103	10	1·0538	18	1·1014	26	1·1529
3	1·0155	11	1·0595	19	1·1076	27	1·1596
4	1·0208	12	1·0653	20	1·1039	28	1·1664
5	1·0261	13	1·0712	21	1·1202	29	1·1732
6	1·0315	14	1·0771	22	1·1266	30	1·1802
7	1·0370	15	1·0331	23	1·1331		
8	1·0426	16	1·0891	24	1·1396		

Potassium Ferrocyanide, $K_4Fe(CN)_6 + Aq$ at 15° C. (Schiff).

Per cent. of Salt −3aq.	Sp. Gr.	Per cent. of Salt −3aq.	Sp. Gr.	Per cent. of Salt −3aq.	Sp. Gr.	Per cent. of Salt −3aq.	Sp. Gr.
1	1·0058	6	1·0356	11	1·0669	16	1·0999
2	1·0116	7	1·0417	12	1·0734	17	1·1067
3	1·0175	8	1·0479	13	1·0800	18	1·1136
4	1·0234	9	1·0542	14	1·0866	19	1·1205
5	1·0295	10	1·0605	15	1·0932	20	1·1275

Ether, $(C_2H_5)_2O$ in Alcohol (Dalton).

Per cent. of Ether.	Sp. Gr.	Per cent. of Ether.	Sp. Gr.	Per cent. of Ether.	Sp. Gr.	Per cent. of Ether.	Sp. Gr.
100	·720	70	·756	40	·792	10	·828
90	·732	60	·768	30	·804	0	·830
80	·744	50	·780	20	·816	=alcohol 87 per cent. by weight	

Fluorhydric Acid, HF + Aq at 15° C. (Hart).

Sp. Gr.	Per cent. of HF.	Sp. Gr.	Per cent. of HF.	Sp. Gr.	Per cent. of HF.	Sp. Gr.	Per cent. of HF.
1·01	2·90	1·08	23·20	1·14	40·60	1·20	58·00
1·02	5·80	1·09	26·10	1·15	43·50	1·21	60·90
1·03	8·70	1·10	29·00	1·16	46·40	1·22	63·80
1·04	11·60	1·11	31·90	1·17	49·30	1·23	66·70
1·05	14·50	1·12	34·80	1·18	52·20	1·24	69·60
1·06	17·40	1·13	37·70	1·19	55·10	1·25	72·50
1·07	20·30						

Fluorides.

Potassium Fluoride, KF + Aq at 18° C.

Per cent. of KF.	Sp. Gr.	Per cent of KF.	Sp. Gr.	Per cent. of KF.	Sp. Gr.
5	1·041	20	1·117	40	1·378
10	1·084	30	1·272		

Sodium Fluoride, NaF + Aq.

Per cent. of NaF.	Sp. Gr.	Per cent. of NaF.	Sp. Gr.	Per cent. of NaF.	Sp. Gr.
1·108	1·0110	2·216	1·0221	3·324	1·0333

Fluosilicic Acid, H_2SiF_6 + Aq at $\frac{17\cdot5}{17\cdot5}$° C. (Stolba).

Per cent. of H_2SiF_6.	Sp. Gr.	Per cent. of H_2SiF_6.	Sp. Gr.	Per cent. of H_2SiF_6.	Sp. Gr.	Per cent. of H_2SiF_6.	Sp. Gr.
2	1·0161	12	1·1011	20	1·1748	28	1·2537
4	1·0324	14	1·1190	22	1·1941	30	1·2742
6	1·0491	16	1·1373	24	1·2136	32	1·2951
8	1·0661	18	1·1559	26	1·2335	34	1·3162
10	1·0834						

Formic Acid, CH_2O_2 + Aq at 15° C. (Gerlach)

Per cent. of CH_2O_2.	Sp. Gr.	Per cent. of CH_2O_2.	Sp. Gr.	Per cent. of CH_2O_2.	Sp. Gr.	Per cent. of CH_2O_2.	Sp. Gr.
1	1·0025	8	1·0200	35	1·0925	70	1·1610
2	1·0050	9	1·0225	40	1·1050	75	1·1705
3	1·0075	10	1·0250	45	1·1145	80	1·1800
4	1·0100	15	1·0390	50	1·1240	85	1·1905
5	1·0125	20	1·0530	55	1·1330	90	1·2010
6	1·0150	25	1·0665	60	1·1420	95	1·2120
7	1·0175	30	1·0800	65	1·1515	100	1·2230

Glycerin, $C_3H_8O_3$ + Aq at ° C. (Nicol; arranged Johnson).

Per cent.	Sp. Gr. $\frac{15}{15}$.	Sp. Gr. $\frac{20}{20}$.	Per cent.	Sp. Gr. $\frac{15}{15}$.	Sp. Gr. $\frac{20}{20}$.
100	1·26596	1·26348	79	1·20949	1·20737
99	1·26335	1·26085	78	1·20677	1·20464
98	1·26072	1·25822	77	1·20404	1·20190
97	1·25809	1·25560	76	1·20131	1·19917
96	1·25547	1·25297	75	1·19857	1·19644
95	1·25285	1·25034	74	1·19583	
94	1·25021	1·24771	73	1·19309	
93	1·24756	1·24508	72	1·19035	
92	1·24487	1·24246	71	1·18761	
91	1·24217	1·23983	70	1·18487	1·18293
90	1·23945	1·23720	69	1·18212	
89	1·23673	1·23449	68	1·17937	
88	1·23400	1·23178	67	1·17662	
87	1·23128	1·22907	66	1·17387	
86	1·22855	1·22636	65	1·17113	
85	1·22583	1·22365	64	1·16837	
84	1·22310	1·22094	63	1·16561	
83	1·22038	1·21823	62	1·16286	
82	1·21766	1·21552	61	1·16011	
81	1·21493	1·21281	60	1·15737	1·15561
80	1·21221	1·21010	59	1·15462	

Glycerin—*continued.*

Per cent.	Sp. Gr. $\frac{15}{15}$.	Sp. Gr. $\frac{20}{20}$.	Per cent.	Sp. Gr. $\frac{15}{15}$.	Sp. Gr. $\frac{20}{20}$.
58	1·15187		45	1·11618	
57	1·14912		40	1·10253	1·10118
56	1·14637		35	1·08908	
55	1·14362		30	1·07564	1·07469
54	1·14088		25	1·06236	
53	1·13814		20	1·04930	1·04884
52	1·13539		15	1·03652	
51	1·13265		10	1·02409	1·02391
50	1·12990	1·12831	5	1·01189	

$$\frac{\text{S.G.} - 1{\cdot}000}{{\cdot}002665\,*} = \text{per cent. by weight of } C_3H_8O_3.$$

Glucose, $C_6H_{12}O_6 + Aq$ at 17·5° C. (Salomon).

Per cent. of $C_6H_{12}O_6$.	Sp. Gr.	Per cent. of $C_6H_{12}O_6$.	Sp. Gr.	Per cent. of $C_6H_{12}O_6$.	Sp. Gr.	Per cent. of $C_6H_{12}O_6$.	Sp. Gr.
5	1·0192	20	1·0762	35	1·1310	50	1·1863
10	1·0381	25	1·0946	40	1·1494	55	1·2040
15	1·0571	30	1·1130	45	1·1680	60	1·2218

Iodates.

POTASSIUM IODATE, $KIO_3 + Aq$ at 19·5° C.
(Kremers; Gerlach).

Per cent. of KIO_3.	Sp.Gr.	Per cent. of KIO_3.	Sp.Gr.	Per cent. of KIO_3.	Sp.Gr.	Per cent. of KIO_3.	Sp.Gr.	Per cent. of KIO_3.	Sp. Gr.
2	1·019	4	1·035	6	1·052	8	1·071	10	1·090

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* Between 60 per cent. and 30 per cent. use ·00261.
Below 30 ,, use ·0025.

Iodates—*continued.*

Sodium Iodate, $NaIO_3$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $NaIO_3$.	Sp. Gr.	Per cent. of $NaIO_3$.	Sp. Gr.	Per cent. of $NaIO_3$.	Sp. Gr.	Per cent. of $NaIO_3$.	Sp. Gr.	Per cent. of $NaIO_3$.	Sp. Gr.
2	1·019	4	1·036	6	1·054	8	1·075	10	1·095

Iodhydric Acid, HI + Aq at 15° C. (Topsöe; cal. Gerlach).

Per cent. of HI.	Sp. Gr.	Per cent. of HI.	Sp. Gr.	Per cent. of HI.	Sp. Gr.	Per cent. of HI.	Sp. Gr.
1	1·008	16	1·127	31	1·283	46	1·491
2	1·015	17	1·137	32	1·295	47	1·508
3	1·022	18	1·146	33	1·307	48	1·525
4	1·029	19	1·155	34	1·320	49	1·543
5	1·037	20	1·165	35	1·333	50	1·561
6	1·045	21	1·175	36	1·346	51	1·579
7	1·053	22	1·185	37	1·359	52	1·597
8	1·061	23	1·195	38	1·372	53	1·615
9	1·069	24	1·205	39	1·386	54	1·634
10	1·077	25	1·216	40	1·400	55	1·654
11	1·085	26	1·227	41	1·414	56	1·674
12	1·093	27	1·238	42	1·429	57	1·694
13	1·102	28	1·249	43	1·444	58	1·713
14	1·110	29	1·260	44	1·459		
15	1·118	30	1·271	45	1·475		

Iodic Acid, HIO_3 + Aq at 15° C. (Kämmerer).

Per cent. of I^2O_5.	Sp. Gr.	Per cent. of I_2O_5.	Sp. Gr.	Per cent. of I_2O_5.	Sp. Gr.	Per cent. of I_2O_5.	Sp. Gr.
1	1·0053	20	1·2093	40	1·5371	60	1·9954
5	1·0263	25	1·2773	45	1·6315	65	2·1269
10	1·0525	30	1·3484	50	1·7356		
15	1·1223	35	1·4428	55	1·8689		

Iron.

Ferric Chloride, Fe_2Cl_6 + Aq at 17·5° C. (Franz).

Per cent. of Fe_2Cl_6.	Sp. Gr.	Per cent. of Fe_2Cl_6.	Sp. Gr.	Per cent. of Fe_2Cl_6.	Sp. Gr.	Per cent. of Fe_2Cl_6.	Sp. Gr.
1	1·0073	16	1·1215	31	1·2673	46	1·4367
2	1·0146	17	1·1297	32	1·2778	47	1·4492
3	1·0219	18	1·1378	33	1·2883	48	1·4617
4	1·0292	19	1·1458	34	1·2988	49	1·4742
5	1·0365	20	1·1542	35	1·3093	50	1·4867
6	1·0439	21	1·1644	36	1·3199	51	1·5010
7	1·0513	22	1·1746	37	1·3305	52	1·5153
8	1·0587	23	1·1848	38	1·3411	53	1·5296
9	1·0661	24	1·1950	39	1·3517	54	1·5439
10	1·0734	25	1·2052	40	1·3622	55	1·5582
11	1·0814	26	1·2155	41	1·3746	56	1·5729
12	1·0894	27	1·2258	42	1·3870	57	1·5876
13	1·0974	28	1·2365	43	1·3994	58	1·6023
14	1·1054	29	1·2464	44	1·4118	59	1·6170
15	1·1134	30	1·2568	45	1·4242	60	1·6317

Lithium Bromide, LiBr + Aq at 19·5° C. (Kremers).

Per cent. of LiBr.	Sp. Gr.	Per cent. of LiBr.	Sp. Gr.	Per cent. of LiBr.	Sp. Gr.	Per cent. of LiBr.	Sp. Gr.
5	1·035	15	1·113	30	1·254	50	1·500
10	1·072	20	1·156	40	1·368	55	1·580

Lithium Chloride, LiCl at 15° C. (Gerlach).

Per cent. of LiCl.	Sp. Gr.	Per cent. of LiCl.	Sp. Gr.	Per cent. of LiCl.	Sp. Gr.
1	1·006	15	1·086	30	1·182
5	1·030	20	1·117	35	1·219
10	1·058	25	1·148	40	1·256

Lithium Iodide, LiI + Aq at 19·5° C. (Kremers).

Per cent. of LiI.	Sp. Gr.	Per cent. of LiI.	Sp. Gr.	Per cent. of LiI.	Sp. Gr.	Per cent. of LiI.	Sp. Gr.	Per cent. of LiI.	Sp. Gr.
5	1·038	15	1·124	25	1·224	35	1·344	50	1·575
10	1·079	20	1·172	30	1·280	40	1·414	60	1·777

Magnesium Bromide, $MgBr_2$ + Aq at 19·5° C. (Kremers).

Per cent. of $MgBr_2$.	Sp. Gr.	Per cent. of $MgBr_2$.	Sp. Gr.	Per cent. of $MgBr_2$.	Sp. Gr.	Per cent. of $MgBr_2$.	Sp. Gr.	Per cent. of $MgBr_2$.	Sp. Gr.
5	1·043	15	1·137	25	1·247	35	1·377	45	1·535
10	1·087	20	1·191	30	1·310	40	1·451	50	1·625

Magnesium Chloride, $MgCl_2$ + Aq at 15° C. (Gerlach).

Per cent. of $MgCl_2$.	Sp. Gr.	Per cent. of $MgCl_2$.	Sp. Gr.	Per cent. of $MgCl_2$.	Sp. Gr.	Per cent. of $MgCl_2$.	Sp. Gr.
1	·0084	10	1·0859	19	1·1686	28	1·2586
2	·0169	11	1·0949	20	1·1780	29	1·2690
3	·0253	12	1·1040	21	1·1879	30	1·2794
4	·0338	13	1·1138	22	1·1977	31	1·2903
5	·0422	14	1·1220	23	1·2076	32	1·3012
6	·0510	15	1·1311	24	1·2175	33	1·3121
7	·0597	16	1·1404	25	1·2274	34	1·3230
8	·0684	17	1·1498	26	1·2378	35	1·3340
9	·0772	18	1·1592	27	1·2482		

Manganous Chloride, $MnCl_2$ + Aq at 15° C. (Gerlach).

a = sp. gr. if per cent. is $MnCl_2$; *b* = per cent. if per cent. is $MnCl_2$, 4 aq.

Per cent.	*a.*	*b.*	Per cent.	*a.*	*b.*	Per cent.	*a.*	*b.*
5	1·045	1·0285	30	1·306	1·180	55	..	1·375
10	1·091	1·057	35	1·372	1·214	60	..	1·419
15	1·138	1·086	40	1·443	1·250	65	..	1·463
20	1·189	1·116	45	1·514	1·290	70	..	1·508
25	1·245	1·147	50	..	1·331			

Mercuric Chloride, $HgCl_2$ + Aq at $^{20}_{4}$° C. (Schröder ; Gerlach).

Per cent. of $HgCl_2$.	Sp. Gr.	Per cent. of $HgCl_2$.	Sp. Gr.	Per cent. of $HgCl_2$.	Sp. Gr.	Per cent. of $HgCl_2$.	Sp. Gr.
1	1·0072	4	1·0323	9	1·0815	12	1·1115
2	1·0148	5	1·0411	10	1·095	13	1·127
3	1·0236	8	*1·0710	11	1·1035		

* From this onwards, Mendelejeff at 15° C.

Methyl Alcohol, CH_4O + Aq at $\frac{0^\circ}{4}$ C. and $\frac{15\cdot56^\circ}{4}$ C.
(Dittmar and Fawsitt).

Per cent. by Wt.	Sp. Gr. 0°.	Sp. Gr. 15·56°.	Per cent. by Wt.	Sp. Gr. 0°.	Sp. Gr. 15·56°.
1	·99806	·99729	63	·90276	·89133
2	·99631	·99554	64	·90056	·88905
4	·99299	·99214	65	·89835	·88676
6	·98990	·98893	66	·89611	·88443
8	·98701	·98569	67	·89384	·88208
10	·98429	·98262	68	·89145	·87970
12	·98171	·97962	69	·88922	·87714
14	·97926	·97668	70	·88687	·87487
16	·97689	·97379	71	·88470	·87262
18	·97459	·97039	72	·88237	·87021
20	·97233	·96808	73	·88003	·86779
22	·97007	·96524	74	·87767	·86535
24	·96780	·96238	75	·87530	·86290
26	·96549	·95949	76	·87290	·86042
28	·96310	·95655	77	·87049	·85793
30	·96057	·95355	78	·86806	·85542
32	·95783	·95053	79	·86561	·85290
34	·95500	·94732	80	·86314	·85035
36	·95204	·94399	81	·86066	·84779
38	·94895	·94055	82	·85816	·84521
40	·94571	·93697	83	·85504	·84262
42	·94239	·93335	84	·85310	·84001
44	·93911	·92975	85	·85055	·83738
46	·93575	·92610	86	·84798	·83473
48	·93229	·92237	87	·84539	·83207
50	·92873	·91855	88	·84278	·82938
51	·92691	·91661	89	·84015	·82668
52	·92507	·91465	90	·83751	·82396
53	·92320	·91267	91	·83485	·82123
54	·92130	·91066	92	·83218	·81849
55	·91938	·90863	93	·82948	·81572
56	·91742	·90657	94	·82677	·81293
57	·91544	·90450	95	·82404	·81013
58	·91343	·90239	96	·82129	·80731
59	·91139	·90026	97	·81853	·80448
60	·90917	·89798	98	·81576	·80164
61	·90706	·89580	99	·81295	·79876
62	·90492	·89358	100	·81015	·79589

Nickel Chloride, $NiCl_2$ + Aq at 17·5° C. (Franz).

Per cent. of $NiCl_2$.	Sp. Gr.	Per cent. of $NiCl_2$.	Sp. Gr.	Per cent. of $NiCl_2$.	Sp. Gr.
5	1·0493	15	1·1578	25	1·3003
10	1·0995	20	1·2245		

Nitrates.

AMMONIUM NITRATE $(NH_4)_2$ NO_3 + Aq at 17·5° C. (Gerlach).

Per cent. of NH_4NO_3	Sp. Gr.	Per cent. of NH_4NO_3	Sp. Gr.	Per cent. of NH_4NO_3	Sp. Gr.	Per cent. of NH_4NO_3	Sp. Gr.
1	1·0042	17	1·0729	33	1·1454	49	1·2249
2	1·0085	18	1·0773	34	1·1502	50	1·2300
3	1·0127	19	1·0816	35	1·1550	51	1·2353
4	1·0170	20	1·0860	36	1·1598	52	1·2407
5	1·0212	21	1·0905	37	1·1646	53	1·2460
6	1·0255	22	1·0950	38	1·1694	54	1·2514
7	1·0297	23	1·0995	39	1·1742	55	1·2567
8	1·0340	24	1·1040	40	1·1790	56	1·2621
9	1·0382	25	1·1085	41	1·1841	57	1·2674
10	1·0425	26	1·1130	42	1·1892	58	1·2728
11	1·0468	27	1·1175	43	1·1942	59	1·2781
12	1·0512	28	1·1220	44	1·1994	60	1·2835
13	1·0555	29	1·1265	45	1·2045	61	1·2888
14	1·0599	30	1·1310	46	1·2096	62	1·2942
15	1·0642	31	1·1358	47	1·2147	63	1·3005
16	1·0686	32	1·1406	48	1·2198	64	1·3059

BARIUM NITRATE, $Ba(NO_3)_2$ + Aq at 17·5° C. (Gerlach).

Per cent. of $Ba(NO_3)_2$.	Sp. Gr.	Per cent. of $Ba(No_3)_2$.	Sp. Gr.	Per cent. of $Ba(NO_3)_2$.	Sp. Gr.
1	1·0085	4	1·0340	7	1·0600
2	1·0170	5	1·0425	8	1·0690
3	1·0255	6	1·0510	saturated	1·0690

Nitrates—*continued.*

CADMIUM NITRATE, $Ca(NO_3)_2$ + Aq at 17·5° C. (Franz).

Per cent. of $Ca(NO_3)_2$.	Sp. Gr.	Per cent. of $Ca(NO_3)_2$.	Sp. Gr.	Per cent. of $Ca(NO_3)_2$.	Sp. Gr.
10	1·0978	30	1·3566	50	1·7608
20	1·2134	40	1·5372		

CALCIUM NITRATE, $Ca(NO_3)_2$ + Aq at 17·5° C. (Franz).

Per cent. of $Ca(NO_3)_2$.	Sp. Gr.	Per cent. of $Ca(NO_3)_2$.	Sp. Gr.	Per cent. of $Ca(NO_3)_2$.	Sp. Gr.	Per cent. of $Ca(NO_3)_2$.	Sp. Gr.
1	1·009	20	*1·163 1·174	35	1·328	50	*1·483 1·515
5	1·045	25	1·222	40	*1·368 1·385	55	1·588
10	*1·076 1·086	30	*1·261 1·272	45	1·447	60	*1·605 1·666
15	1·129						

* Gerlach's results at same temperature.

COBALT NITRATE, $Co(NO_3)_2$ + Aq at 17·5° C. (Franz).

Per cent. of $Co(NO_3)_2$.	Sp. Gr.	Per cent. of $Co(NO_3)_2$.	Sp. Gr.	Per cent. of $Co(NO_3)_2$.	Sp. Gr.	Per cent. of $Co(NO_3)_2$.	Sp. Gr.
10	1·0906	20	1·1936	30	1·3190	40	1·4662

COPPER NITRATE, $Cu(NO_3)_2$ + Aq at 17·5° C. (Franz).

Per cent. of $Cu(NO_3)_2$.	Sp. Gr.	Per cent. of $Cu(NO_3)_2$.	Sp. Gr.	Per cent. of $Cu(NO_3)_2$.	Sp. Gr.
10	1·0942	30	1·3299	44	1·5404
20	1·2037	40	1·4724	45	1·5576

Nitrates—*continued.*

Iron (Ferric) Nitrate, $Fe_2(NO_3)_6$ + Aq at 17·5° C. (Franz).

Per cent. of $Fe_2(NO_3)_6$.	Sp. Gr.	Per cent. of $Fe_2(NO_3)_6$.	Sp. Gr.	Per cent. of $Fe_2(NO_3)_6$.	Sp. Gr.
10	1·0770	30	1·2622	50	1·4972
20	1·1612	40	1·3746	60	1·6572

Lead Nitrate, $Pb(NO_3)_2$ + Aq at 17·5° C. (Schiff; cal. Gerlach).

Per cent. of $Pb(NO_3)_2$.	Sp. Gr.	Per cent. of $Pb(NO_3)_2$.	Sp. Gr.	Per cent. of $Pb(NO_3)_2$.	Sp. Gr.	Per cent. of $Pb(NO_3)_2$.	Sp. Gr.
1	1·0080	11	1·0963	21	1·2016	31	1·3726
2	1·0163	12	1·1059	22	1·2132	32	1·3416
3	1·0247	13	1·1157	23	1·2251	33	1·3558
4	1·0331	14	1·1257	24	1·2372	34	1·3702
5	1·0416	15	1·1359	25	1·2495	35	1·3848
6	1·0502	16	1·1463	26	1·2620	36	1·3996
7	1·0591	17	1·1569	27	1·2747	37	1·4146
8	1·0682	18	1·1677	28	1·2876		
9	1·0775	19	1·1788	29	1·2907		
10	1·0869	20	1·1902	30	1·3140		

Magnesium Nitrate, $Mg(NO_3)_2$ + Aq at 14° C. (Oudemann).

Per cent. of $Mg(NO_3)_2 6aq$.	Sp. Gr.	Per cent. of $Mg(NO_3)_2 6aq$.	Sp. Gr.	Per cent. of $Mg(NO_3)_2 6aq$.	Sp. Gr.	Per cent. of $Mg(NO_3)_2 6aq$.	Sp. Gr.
1	1·0034	15	1·0639	30	1·1347	45	1·2176
5	1·0202	20	1·0869	35	1·1649	49	1·2397
10	1·0418	25	1·1103	40	1·1909		

Nitrates—*continued.*

MANGANOUS NITRATE, $Mn(NO_3)_2$ + Aq at 8° C. (Oudemann).

Per cent. of $Mn(NO_3)_2 6aq.$	Sp. Gr.	Per cent. of $Mn(NO_3)_2 6aq.$	Sp. Gr.	Per cent. of $Mn(NO_3)_2 6aq.$	Sp. Gr.	Per cent. of $Mn(NO_3)_2 6aq.$	Sp. Gr.
5	1·0253	25	1·1137	45	1·2705	65	1·4281
10	1·0517	30	1·1688	50	1·3074	70	1·4721
15	1·0792	35	1·2012	55	1·3459	71	1·4811
20	1·1078	40	1·2352	60	1·3861		

POTASSIUM NITRATE, KNO_3 + Aq at 15° C. (Gerlach).

Per cent. of KNO_3.	Sp. Gr.	Per cent. of KNO_3.	Sp. Gr.	Per cent. of KNO_3.	Sp. Gr.	Per cent. of KNO_3.	Sp. Gr.
1	1·0064	7	1·0453	13	1·0860	19	1·1287
2	1·0128	8	1·0520	14	1·0929	20	1·1360
3	1·0192	9	1·0586	15	1·0998	21	1·1436
4	1·0257	10	1·0652	16	1·1070		
5	1·0321	11	1·0721	17	1·1143		
6	1·0387	12	1·0790	18	1·1215		

SILVER NITRATE, $AgNO_3$ + Aq at 17·5° C. (Franz).

Per cent. of $AgNO_3$.	Sp. Gr.	Per cent. of $AgNO_3$.	Sp. Gr.	Per cent. of $AgNO_3$.	Sp. Gr.
20	1·160	25	1·206	30	1·251

Nitrates—*continued.*

SODIUM NITRATE, $NaNO_3$ + Aq at 20·2° C. (Schiff; cal. Gerlach).

Per cent. of $NaNO_3$.	Sp. Gr.	Per cent. of $NaNO_3$.	Sp. Gr.	Per cent. of $NaNO_3$.	Sp. Gr.	Per cent. of $NaNO_3$.	Sp. Gr.
1	1·0065	14	1·0962	27	1·1987	40	1·3155
2	1·0131	15	1·1035	28	1·2070	41	1·3225
3	1·0197	16	1·1109	29	1·2154	42	1·3355
4	1·0264	17	1·1184	30	1·2239	43	1·3456
5	1·0332	18	1·1260	31	1·2325	44	1·3557
6	1·0399	19	1·1338	32	1·2412	45	1·3659
7	1·0468	20	1·1418	33	1·2500	46	1·3761
8	1·0537	21	1·1498	34	1·2589	47	1·3864
9	1·0606	22	1·1578	35	1·2679	48	1·3968
10	1·0676	23	1·1659	36	1·2770	49	1·4074
11	1·0746	24	1·1740	37	1·2863	50	1·4180
12	1·0817	25	1·1822	38	1·2958		
13	1·0889	26	1·1904	39	1·3055		

STRONTIUM NITRATE, $Sr(NO_3)_2$ + Aq at 19·5° C. (Kremers; cal. Gerlach).

Per cent. of $Sr(NO_3)_2$.	Sp. Gr.	Per cent. of $Sr(NO_3)_2$.	Sp. Gr.	Per cent. of $Sr(NO_3)_2$.	Sp. Gr.	Per cent. of $Sr(NO_3)_2$.	Sp. Gr.
1	1·009	11	1·095	21	1·192	31	1·304
2	1·017	12	1·103	22	1·202	32	1·316
3	1·025	13	1·113	23	1·213	33	1·330
4	1·034	14	1·122	24	1·223	34	1·340
5	1·041	15	1·131	25	1·233	35	1·354
6	1·049	16	1·140	26	1·246	36	1·367
7	1·059	17	1·150	27	1·257	37	1·381
8	1·068	18	1·160	28	1·268	38	1·395
9	1·076	19	1·170	29	1·280	39	1·410
10	1·085	20	1·181	30	1·292	40	1·422

Nitrates—*continued.*

ZINC NITRATE, $Zn(NO_3)_2$ + Aq at 17·5° C. (Franz).

Per cent. of $Zn(NO_3)_2$.	Sp. Gr.	Per cent. of $Zn(NO_3)_2$.	Sp. Gr.	Per cent. of $Zn(NO_3)_2$.	Sp. Gr.
10	1·0968	30	1·3268	50	1·5984
20	1·2024	40	1·4572		

Nitric Acid, HNO_3 + Aq at $\frac{15°}{4°}$ C. (Lunge and Ray).

$HNO_3 \times \cdot 8571 = N_2O_5$.

Sp. Gr. $\frac{15}{4}$	Per cent. of HNO_3 by wt.	Per cent. of N_2O_5 by wt.	Kg. per l.	Sp. Gr. $\frac{15}{4}$	Per cent. of HNO_3 by wt.	Per cent. of N_2O_5 by wt.	Kg. per l.
1·000	0·10	0·08	0·001	1·125	21·00	18·00	0·236
1·005	0·20	0·85	0·010	1·130	21·77	18·66	0·246
1·010	1·90	1·62	0·019	1·135	22·54	19·32	0·256
1·015	2·80	2·39	0·028	1·140	23·31	19·98	0·266
1·020	3·70	3·17	0·038	1·145	24·08	20·64	0·276
1·025	4·60	3·94	0·047	1·150	24·84	21·29	0·286
1·030	5·50	4·71	0·057	1·155	25·60	21·94	0·296
1·035	6·38	5·47	0·066	1·160	26·36	22·60	0·306
1·040	7·26	6·22	0·075	1·165	27·12	23·25	0·316
1·045	8·13	6·97	0·085	1·170	27·88	23·90	0·326
1·050	8·99	7·71	0·094	1·175	28·63	24·54	0·336
1·055	9·84	8·43	0·104	1·180	29·38	25·18	0·347
1·060	10·68	9·15	0·113	1·185	30·13	25·83	0·357
1·065	11·51	9·87	0·123	1·190	30·88	26·47	0·367
1·070	12·33	10·57	0·132	1·195	31·62	27·10	0·378
1·075	13·15	11·27	0·141	1·200	32·36	27·74	0·388
1·080	13·95	11·96	0·151	1·205	33·09	28·36	0·399
1·085	14·74	12·64	0·160	1·210	33·82	28·99	0·409
1·090	15·53	13·31	0·169	1·215	34·55	29·61	0·420
1·095	16·32	13·99	0·179	1·220	35·28	30·24	0·430
1·100	17·11	14·67	0·188	1·225	36·03	30·80	0·441
1·105	17·89	15·34	0·198	1·230	36·78	31·53	0·452
1·110	18·67	16·00	0·207	1·235	37·53	32·17	0·463
1·115	19·45	16·67	0·217	1·240	38·29	32·82	0·475
1·120	20·23	17·34	0·227	1·245	39·05	33·47	0·486

Nitric Acid—*continued.*

Sp. Gr. $\frac{15}{4}$	Per cent. of HNO_3 by wt.	Per cent. of N_2O_5 by wt.	Kg. per l.	Sp. Gr. $\frac{15}{4}$	Per cent. of HNO_3 by wt.	Per cent. of N_2O_5 by wt.	Kg. per l.
1·250	39·82	34·13	0·498	1·430	72·17	61·86	1·032
1·255	40·58	34·78	0·509	1·435	73·39	62·91	1·053
1·260	41·34	35·44	0·521	1·440	74·68	64·01	1·075
1·265	42·10	36·09	0·533	1·445	75·98	65·13	1·098
1·270	42·87	36·75	0·544	1·450	77·28	66·24	1·121
1·275	43·64	37·41	0·556	1·455	78·60	67·38	1·144
1·280	44·41	38·07	0·568	1·460	79·98	68·56	1·168
1·285	45·18	38·73	0·581	1·465	81·42	69·79	1·193
1·290	45·95	39·39	0·573	1·470	82·90	71·06	1·219
1·295	46·72	40·05	0·605	1·475	84·45	72·39	1·246
1·300	47·49	40·71	0·617	1·480	86·05	73·76	1·274
1·305	48·26	41·37	0·630	1·485	87·70	75·18	1·202
1·310	49·07	42·06	0·643	1·490	89·60	76·80	1·335
1·315	49·89	42·76	0·656	1·495	91·60	78·57	1·369
1·320	50·71	43·47	0·669	1·500	94·09	80·65	1·411
1·325	51·53	44·17	0·683	1·501	94·60	81·09	1·420
1·330	52·37	44·89	0·697	1·502	95·08	81·50	1·428
1·335	53·22	45·62	0·710	1·503	95·55	81·91	1·436
1·340	54·07	46·35	0·725	1·504	96·00	82·29	1·444
1·345	54·93	47·08	0·739	1·505	96·39	82·63	1·451
1·350	55·79	47·82	0·753	1·506	96·76	82·94	1·457
1·355	56·66	48·57	0·768	1·507	97·13	83·26	1·464
1·360	57·57	49·35	0·783	1·508	97·50	83·58	1·470
1·365	58·48	50·13	0·798	1·509	97·84	83·87	1·476
1·370	59·39	50·91	0·814	1·510	98·10	84·09	1·481
1·375	60·30	51·69	0·829	1·511	98·32	84·28	1·486
1·380	61·27	52·52	0·846	1·512	98·53	84·46	1·490
1·385	62·24	53·35	0·862	1·513	98·73	84·63	1·484
1·390	63·23	54·20	0·879	1·514	98·90	84·78	1·497
1·395	64·25	55·07	0·896	1·515	99·07	84·92	1·501
1·400	65·30	55·97	0·914	1·516	99·21	85·04	1·504
1·405	66·40	56·92	0·933	1·517	99·34	85·15	1·507
1·410	67·50	57·86	0·952	1·518	99·46	85·26	1·510
1·415	68·63	58·83	0·971	1·519	99·57	85·35	1·512
1·420	69·80	59·83	0·991	1·520	99·67	85·44	1·515
1·425	70·98	60·81	1·011				

Oxalate.

Potassium Oxalate, $K_2C_2O_4 + Aq$ at 17·5° C. (Franz).

Per cent. of Salt, 1aq.	Sp. Gr.	Per cent. of Salt, 1aq.	Sp. Gr.	Per cent. of Salt, 1aq.	Sp. Gr.	Per cent. of Salt, 1aq.	Sp. Gr.
2	1·0134	8	1·0529	14	1·0912	20	1·1306
4	1·0268	10	1·0656	16	1·1043	22	1·1438
6	1·0401	12	1·0784	18	1·1175	24	1·1570

Oxalic Acid, $C_2H_2O_4 + Aq$ at 17·5° C. (Gerlach).

Per cent. of $C_2H_4O_2$.	Sp. Gr.	Per cent. of $C_2H_4O_2$,2aq.	Per cent. of $C_2H_4O_2$.	Sp. Gr.	Per cent. of $C_2H_4O_2$,2aq.
0	1·000	0	5·7136	1·028	8
1·4284	1·007	2	7·1420	1·035	10
2·8568	1·014	4	8·5704	1·042	12
4·2852	1 021	6	9·1285	1·0455	13

Phosphates.

Sodium Hydrogen Phosphate, $Na_2HPO_4 + Aq$ at 19° C. (Schiff).

Per cent. of Na_2HPO_4,12aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·0041	4	1·0166	7	1·0292	10	1·0418
2	1·0083	5	1·0208	8	1·0332	11	1·0460
3	1·0125	6	1·0250	9	1·0376	12	1·0503

Phosphates—*continued.*

Sodium Phosphate, Na_3PO_4+Aq at 15° C. (Schiff; cal. Gerlach).
Per cent. of $Na_3PO_4,12aq$.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·0043	7	1·0308	13	1·0586	19	1·0876
2	1·0086	8	1·0353	14	1·0633	20	1·0925
3	1·0130	9	1·0399	15	1·0681	21	1·0975
4	1·0174	10	1·0455	16	1·0729	22	1·1025
5	1·0218	11	1·0492	17	0·0778	23	1·1076
6	1·0263	12	1·0539	18	1·0827	24	1·1127

Phosphoric Acid, H_3PO_4+Aq at 15° C.

(Schiff; cal. Gerlach).

a = S.G. if per cent. is P_2O_5; b = S.G. if per cent. is H_3PO_4.

Per cent.	a	b	Per cent.	a	b	Per cent.	a	b
1	1·009	1·0054	21	1·182	1·1262	41	1·407	1·2731
2	1·017	1·0109	22	1·192	1·1329	42	1·420	1·2812
3	1·025	1·0164	23	1·202	1·1397	43	1·432	1·2894
4	1·032	1·0220	24	1·212	1·1465	44	1·445	1·2976
5	1·039	1·0276	25	1·223	1·1534	45	..	1·3059
6	1·047	1·0333	26	1·233	1·1604	46	..	1·3143
7	1·055	1·0390	27	1·244	1·1674	47	..	1·3227
8	1·063	1·0449	28	1·254	1·1745	48	..	1·3313
9	1·071	1·0508	29	1·265	1·1817	49	..	1·3399
10	1·080	1·0567	30	1·277	1·1889	50	..	1·3486
11	1·089	1·0627	31	1·288	1·1962	51	..	1·3573
12	1·098	1·0688	32	1·299	1·2036	52	..	1·3661
13	1·106	1·0749	33	1·310	1·2111	53	..	1·3750
14	1·115	1·0811	34	1·321	1·2186	54	..	1·3840
15	1·124	1·0874	35	1·333	1·2262	55	..	1·3931
16	1·133	1·0937	36	1·345	1·2338	56	..	1·4022
17	1·142	1·1001	37	1·357	1·2415	57	..	1·4114
18	1·151	1·1065	38	1·369	1·2493	58	..	1·4207
19	1·161	1·1130	39	1·381	1·2572	59	..	1·4301
20	1·171	1·1196	40	1·393	1·2651	60	..	1·4395

Platinic Chloride, $PtCl_4$ + Aq. (Precht).

Per cent. of $PtCl_4$.	Sp. Gr.	Per cent. of $PtCl_4$.	Sp. Gr.	Per cent. of $PtCl_4$.	Sp. Gr.	Per cent. of $PtCl_4$.	Sp. Gr.
1	1·009	14	1·141	27	1·315	40	1·546
2	1·018	15	1·153	28	1·330	41	1·568
3	1·027	16	1·165	29	1·346	42	1·591
4	1·036	17	1·176	30	1·362	43	1·615
5	1·046	18	1·188	31	1·387	44	1·641
6	1·056	19	1·201	32	1·395	45	1·666
7	1·066	20	1·214	33	1·413	46	1·688
8	1·076	21	1·227	34	1·431	47	1·712
9	1·086	22	1·242	35	1·450	48	1·736
10	1·097	23	1·256	36	1·469	49	1·760
11	1·108	24	1·270	37	1·488	50	1·785
12	1·119	25	1·285	38	1·500		
13	1·130	26	1·300	39	1·523		

Potassium Bromide, KBr + Aq at 19·5. (Gerlach).

Per cent. of KBr.	Sp. Gr.	Per cent. of KBr.	Sp. Gr.	Per cent. of KBr.	Sp. Gr.	Per cent. of KBr.	Sp. Gr.	Per cent. of KBr.	Sp. Gr.
5	1·037	15	1·116	25	1·207	35	1·309	45	1·430
10	1·075	20	1·159	30	1·256	40	1·366	50	1·500

Potassium Chloride, KCl + Aq at 15° C. (Gerlach).

Per cent. of KCl.	Sp. Gr.	Per cent. of KCl.	Sp. Gr.	Per cent. of KCl.	Sp. Gr.	Per cent. of KCl.	Sp. Gr.
1	1·0065	8	1·0525	15	1·1004	22	1·1509
2	1·0130	9	1·0591	16	1·1075	23	1·1583
3	1·0195	10	1·0658	17	1·1146	24	1·1657
4	1·0260	11	1·0727	18	1·1218	24·9 (satd.)	1·1723
5	1·0325	12	1·0796	19	1·1289		
6	1·0392	13	1·0865	20	1·1361		
7	1·0458	14	1·0934	21	1·1435		

Potassium Hydroxide, KOH + Aq at 15° C. (Zimmerman, Schiff; cal. Gerlach).

a = S.G. if per cent. is K_2O; b = S.G. if per cent. is KOH.

Per cent.	*a*	*b*	Per cent.	*a*	*b*	Per cent.	*a*	*b*
1	1·010	1·009	21	1·230	1·188	41	1·522	1·425
2	1·020	1·017	22	1·242	1·198	42	1·539	1·438
3	1·030	1·025	23	1·256	1·209	43	1·564	1·450
4	1·039	1·033	24	1·270	1·220	44	1·570	1·462
5	1·048	1·041	25	1·285	1·230	45	1·584	1·472
6	1·058	1·049	26	1·300	1·241	46	1·600	1·488
7	1·068	1·058	27	1·312	1·252	47	1·615	1·499
8	1·078	1·065	28	1·326	1·264	48	1·630	1·511
9	1·089	1·074	29	1·340	1·278	49	1·645	1·527
10	1·099	1·083	30	1·355	1·288	50	1·660	1·539
11	1·110	1·092	31	1·370	1·300	51	1·676	1·552
12	1·121	1·110	32	1·385	1·311	52	1·690	1·565
13	1·132	1·111	33	1·403	1·324	53	1·705	1·578
14	1·143	1·119	34	1·418	1·336	54	1·720	1·590
15	1·154	1·128	35	1·431	1·349	55	1·733	1·604
16	1·166	1·137	36	1·445	1·361	56	1·746	1·618
17	1·178	1·146	37	1·460	1·374	57	1·762	1·630
18	1·190	1·155	38	1·475	1·387	58	1·780	1·641
19	1·202	1·166	39	1·490	1·400	59	1·795	1·655
20	1·215	1·177	40	1·504	1·411	60	1·810	1·667

Potassium Iodide, KI + Aq at 21° C. (Schiff).

Per cent. of KI.	Sp. Gr.	Per cent. of KI.	Sp. Gr.	Per cent. of KI.	Sp. Gr.	Per cent. of KI.	Sp. Gr.
1	1·0075	16	1·1318	31	1·2899	46	1·4982
2	1·0151	17	1·1412	32	1·3017	47	1·5142
3	1·0227	18	1·1508	33	1·3138	48	1·5305
4	1·0305	19	1·1605	34	1·3262	49	1·5471
5	1·0384	20	1·1705	35	1·3389	50	1·5640
6	1·0464	21	1·1807	36	1·3519	51	1·5810
7	1·0545	22	1·1911	37	1·3653	52	1·5984
8	1·0627	23	1·2016	38	1·3791	53	1·6162
9	1·0710	24	1·2122	39	1·3933	54	1·6343
10	1·0793	25	1·2229	40	1·4079	55	1·6528
11	1·0877	26	1·2336	41	1·4224	56	1·6717
12	1·0962	27	1·2445	42	1·4371	57	1·6911
13	1·1048	28	1·2556	43	1·4520	58	1·7109
14	1·1136	29	1·2699	44	1·4671	59	1·7311
15	1·1226	30	1·2784	45	1·4825	60	1·7517

Rubidium Chloride, RbCl + Aq. (Tammann).

Per cent. of RbCl.	Sp. Gr.	Per cent. of RbCl.	Sp. Gr.	Per cent. of RbCl.	Sp. Gr.
13·14	1·1066	25·88	1·2156	33·13	1·2675

Selenic Acid, H_2SeO_4 + Aq at 15° C. (Cameron and Macallan).

Per cent. of H_2SeO_4.	Sp. Gr.	Per cent. of H_2SeO_4.	Sp. Gr.	Per cent. of H_2SeO_4.	Sp. Gr.	Per cent. of H_2SeO_4.	Sp. Gr.
99·73	2·6083	96	2·5388	89	2·3568	82	2·1757
99·50	2·6051	95	2·5163	88	2·3291	81	2·1479
99·00	2·5975	94	2·4925	87	2·3061	80	2·1216
98·5	2·5863	93	2·4596	86	2·2795	79	2·0922
98·0	2·5767	92	2·4322	85	2·2558	73·5	1·9675
97·5	2·5695	91	2·4081	84	2·2258		
97·0	2·5601	90	2·3848	83	2·1946		

Sodium Bromide, NaBr + Aq at 19·5° C. (Gerlach).

Per cent. of NaBr.	Sp. Gr.	Per cent. of NaBr.	Sp. Gr.	Per cent. of NaBr.	Sp. Gr.	Per cent. of NaBr.	Sp. Gr.	Per cent. of NaBr.	Sp. Gr.
5	1·040	15	1·125	25	1·226	35	1·344	45	1·483
10	1·080	20	1·174	30	1·281	40	1·410	50	1·565

Sodium Chloride, NaCl + Aq at 15° (Gerlach).

Per cent. of NaCl.	Sp. Gr.	Per cent. of NaCl.	Sp. Gr.	Per cent. of NaCl.	Sp. Gr.	Per cent. of NaCl.	Sp. Gr.
1	1·0072	8	1·0585	15	1·1115	22	1·1675
2	1·0145	9	1·0659	16	1·1194	23	1·1758
3	1·0217	10	1·0733	17	1·1273	24	1·1840
4	1·0290	11	1·0810	18	1·1352	25	1·1923
5	1·0362	12	1·0886	19	1·1431	26	1·2010
6	1·0437	13	1·0962	20	1·1511	26·395	1·2043
7	1·0511	14	1·1038	21	1·1593		

Sodium Hydroxide, NaOH + Aq at 15° C.
(given by Lunge).

Sp. Gr.	Grms. per litre. Na_2O.	Lbs. per cubic foot.		
		Na_2O.	48 per cent. Ash.	60 per cent. Caustic.
1·005	3·7	·23	·49	·39
1·010	7·5	·47	·98	·78
1·015	11·3	·70	1·47	1·17
1·020	15·1	·94	1·96	1·56
1·025	18·8	1·17	2·45	1·96
1·030	22·6	1·41	2·94	2·35
1·035	26·4	1·64	3·43	2·74
1·040	30·2	1·88	3·92	3·13
1·045	33·9	2·11	4·41	3·53
1·050	37·7	2·35	4·90	3·92
1·055	41·6	2·59	5·41	4·32
1·060	45·5	2·83	5·91	4·73
1·065	49·4	3·08	6·41	5·13
1·070	53·2	3·32	6·92	5·53
1·075	57·1	3·56	7·42	5·94
1·080	61·0	3·80	7·93	6·34
1·085	64·9	4·04	8·43	6·74
1·090	68·8	4·29	8·93	7·15
1·095	72·7	4·53	9·44	7·55
1·100	76·5	4·77	9·94	7·95
1·105	80·4	5·01	10·45	8·36
1·110	84·3	5·25	10·95	8·76
1·115	88·2	5·50	11·46	9·16
1·120	92·1	5·74	11·96	9·57
1·125	96·0	5·98	12·46	9·97
1·130	100·5	6·26	13·05	10·44
1·135	105·0	6·55	13·64	10·91
1·140	109·6	6·83	14·23	11·38
1·145	114·1	7·11	14·82	11·86
1·150	118·6	7·39	15·41	12·33
1·155	123·2	7·68	16·00	12·80
1·160	127·7	7·96	16·59	13·27
1·165	132·2	8·24	17·18	13·74

Sodium Hydroxide—*continued.*

Sp. Gr.	Grms. per litre. Na_2O.	Lbs. per cubic foot.		
		Na_2O.	48 per cent. Ash.	60 per cent. Caustic.
1·170	136·8	8·53	17·77	14·21
1·175	141·3	8·81	18·36	14·68
1·180	145·8	9·09	18·94	15·15
1·185	150·4	9·37	19·53	15·63
1·190	154·9	9·66	20·12	16·10
1·195	159·4	9·94	20·71	16·57
1·200	164·0	10·22	21·30	17·04
1·205	169·4	10·56	22·00	17·60
1·210	174·7	10·89	22·70	18·16
1·215	180·1	11·23	23·40	18·72
1·220	185·5	11·56	24·10	19·28
1·225	190·9	11·90	24·80	19·84
1·230	196·3	12·24	25·50	20·40
1·235	201·7	12·57	26·20	20·96
1·240	207·0	12·91	26·89	21·51
1·245	212·4	13·24	27·59	22·07
1·250	217·8	13·58	28·29	22·63
1·255	223·4	13·92	29·01	23·21
1·260	228·9	14·27	29·73	23·78
1·265	234·4	14·61	30·45	24·36
1·270	240·0	14·96	31·17	24·93
1·275	245·5	15·31	31·89	25·51
1·280	251·0	15·65	32·61	26·08
1·285	256·6	16·00	33·33	26·66
1·290	262·1	16·34	34·05	27·24
1·295	267·6	16·69	34·77	27·81
1·300	273·2	17·03	35·48	28·39
1·305	279·3	17·41	36·28	29·02
1·310	285·4	17·79	37·07	29·66
1·315	291·5	18·18	37·87	30·29
1·320	297·7	18·56	38·67	30·93
1·325	303·8	18·94	39·46	31·57
1·330	309·9	19·32	40·26	32·20
1·335	316·0	19·70	41·05	32·84
1·340	322·2	20·08	41·85	33·47

Sodium Hydroxide—*continued.*

Sp. Gr.	Grms. per litre. Na_2O.	Lbs. per cubic foot.		
		Na_2O.	48 per cent. Ash.	60 per cent. Caustic.
1·345	328·3	20·47	42·64	34·11
1·350	334·4	20·85	43·44	34·75
1·355	340·8	21·25	44·27	35·41
1·360	347·2	21·65	45·10	36·08
1·365	353·6	22·05	45·94	36·75
1·370	360·1	22·45	46·77	37·41
1·375	366·5	22·85	47·60	38·08
1·380	372·9	23·25	48·44	38·75
1·385	379·3	23·65	49·27	39·41
1·390	385·7	24·05	50·10	40·08
1·395	392·1	24·45	50·94	40·75
1·400	398·5	24·85	51·77	41·41
1·405	405·2	25·26	52·63	42·10
1·410	411·8	25·67	53·49	42·79
1·415	418·4	26·08	54·34	43·47
1·420	425·0	26·50	55·20	44·16
1·425	431·6	26·91	56·06	44·85
1·430	438·2	27·32	56·92	45·53
1·435	444·8	27·73	57·78	46·22
1·440	451·4	28·14	58·63	46·91
1·445	458·0	28·56	59·49	47·59
1·450	464·6	28·97	60·35	48·28
1·455	472·3	29·44	61·34	49·07
1·460	479·9	29·92	62·53	49·86
1·465	487·6	30·39	63·32	50·65
1·470	495·3	30·87	64·31	51·44
1·475	502·9	31·34	65·29	52·23
1·480	510·6	31·82	66·28	53·02
1·485	518·2	32·29	67·27	53·81
1·490	525·9	32·76	68·26	54·60
1·495	533·6	33·28	69·25	55·40
1·500	541·2	33·75	70·30	56·24

Sodium Hydroxide, NAHO + Aq. at 15° C.

(Schiff; Gerlach).

Per cent.	Sp. Gr. if per cent. is Na_2O.	Sp. Gr. if per cent. is NaHO.	Per cent.	Sp. Gr. if per cent. is Na_2O.	Sp. Gr. if per cent. is NaHO.
1	1·015	1·012	32	1·450	1·351
2	1·020	1·023	33	1·462	1·363
3	1·043	1·035	34	1·475	1·374
4	1·058	1·846	35	1·488	1·384
5	1·074	1·059	36	1·500	1·395
6	1·089	1·070	37	1·515	1·405
7	1·104	1·081	38	1·530	1·415
8	1·119	1·092	39	1·543	1·426
9	1·132	1·103	40	1·558	1·437
10	1·145	1·115	41	1·570	1·447
11	1·160	1·126	42	1·583	1·456
12	1·175	1·137	43	1·597	1·468
13	1·190	1·148	44	1·610	1·478
14	1·203	1·159	45	1·623	1·488
15	1·219	1·170	46	1·637	1·499
16	1·233	1·181	47	1·650	1·508
17	1·245	1·192	48	1·663	1·519
18	1·258	1·202	49	1·678	1·529
19	1·270	1·213	50	1·690	1·540
20	1·285	1·225	51	1·705	1·550
21	1·300	1·236	52	1·719	1·560
22	1·315	1·247	53	1·730	1·570
23	1·329	1·258	54	1·745	1·580
24	1·341	1·269	55	1·760	1·591
25	1·355	1·279	56	1·770	1·601
26	1·369	1·290	57	1·785	1·611
27	1·381	1·300	58	1·800	1·622
28	1·395	1·310	59	1·815	1·633
29	1·410	1·321	60	1·830	1·643
30	1·422	1·332	70		1·748
31	1·438	1·343			

Sodium Iodide, NaI + Aq at 19·5° C. (Gerlach).

Per cent. of NaI.	Sp. Gr.	Per cent. of NaI.	Sp. Gr.	Per cent. of NaI.	Sp. Gr.	Per cent. of NaI.	Sp. Gr.	Per cent. of NaI.	Sp. Gr.
5	1·040	15	1·128	25	1·234	35	1·360	50	1·600
10	1·082	20	1·179	30	1·294	40	1·432	60	1·810

Strontium Bromide, $SrBr_2$ + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of $SrBr_2$.	Sp.Gr.	Per cent. of $SrBr_2$.	Sp.Gr.	Per cent. of $SrBr_2$.	Sp.Gr.	Per cent. of $SrBr_2$.	Sp.Gr.	Per cent. of $SrBr_2$.	Sp.Gr.
5	1·046	15	1·146	25	1·266	35	1·410	45	1·590
10	1·094	20	1·204	30	1·332	40	1·492	50	1·694

Strontium Chloride, $SrCl_2$ + Aq at 15° C. (Gerlach).

Per cent. of $SrCl_2$.	Sp. Gr.	Per cent. of $SrCl_2$.	Sp. Gr.	Per cent. of $SrCl_2$.	Sp. Gr.	Per cent. of $SrCl_2$.	Sp. Gr.
5	1·0453	15	1·1439	25	1·2580	33	1·3633
10	1·0923	20	1·1989	30	1·3220		

Strontium Iodide, SrI_2 + Aq at 19·5° C. (Kremers; Gerlach).

Per cent. of SrI_2.	Sp. Gr.	Per cent. of SrI_2.	Sp. Gr.	Per cent. of SrI_2.	Sp. Gr.	Per cent. of SrI_2.	Sp. Gr.
5	1·045	20	1·200	35	1·410	50	1·695
10	1·091	25	1·262	40	1·491	55	1·812
15	1·142	30	1·330	45	1·590	60	1·955

Sulphates.

ALUMINIUM SULPHATE, $Al_2(SO_4)_3$ + Aq at –° C. (Reuss).

Per cent. of $Al_2(SO_4)_3$.	Sp. Gr. at			
	15°.	25°.	35°.	45°.
5	1·0569	1·0503	1·045	1·0356
10	1·1071	1·1022	1·096	1·085
15	1·1574	1·1522	1·146	1·1346
20	1·2074	1·2004	1·192	1·1801
25	1·2572	1·2483	1·2407	1·2295

Sulphates—*continued.*

AMMONIUM ALUMINIUM SULPHATE, $NH_4Al(SO_4)_2$ + Aq at 15° C. (Gerlach).

Per cent. of Salt, 12aq.	Per cent. of Anhy. Salt.	Sp. Gr.
3	1·5013	1·0141
6	3·0025	1·0282
9	4·5038	1·0423

AMMONIUM FERROUS SULPHATE, $(NH_4)_2Fe(SO_4)_2$ + Aq at 19° C. (Schiff; cal. Gerlach).

Per cent. = Per cent. of $(Am)_2Fe(SO_4)_2 6aq$.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·006	9	1·054	17	1·104	25	1·156
2	1·013	10	1·060	18	1·110	26	1·164
3	1·018	11	1·066	19	1·116	27	1·171
4	1·024	12	1·073	20	1·124	28	1·179
5	1·030	13	1·080	21	1·130	29	1·185
6	1·036	14	1·085	22	1·136	30	1·193
7	1·042	15	1·092	23	1·143		
8	1·047	16	1·097	24	1·150		

AMMONIUM SULPHATE, $(NH_4)_2SO_4$ + Aq at 15° C. (Schiff; cal. Gerlach).

Per cent. of Am_2SO_4.	Sp. Gr.	Per cent. of Am_2SO_4.	Sp. Gr.	Per cent. of Am_2SO_4.	Sp. Gr.	Per cent. of Am_2SO_4.	Sp. Gr.
1	1·0057	14	1·0805	27	1·1554	40	1·2284
2	1·0115	15	1·0862	28	1·1612	41	1·2343
3	1·0172	16	1·0920	29	1·1670	42	1·2402
4	1·0230	17	1·0977	30	1·1724	43	1·2462
5	1·0287	18	1·1035	31	1·1780	44	1·2522
6	1·0345	19	1·1092	32	1·1836	45	1·2583
7	1·0403	20	1·1149	33	1·1892	46	1·2644
8	1·0460	21	1·1207	34	1·1948	47	1·2705
9	1·0518	22	1·1265	35	1·2004	48	1·2766
10	1·0575	23	1·1323	36	1·2060	49	1·2828
11	1·0632	24	1·1381	37	1·2116	50	1·2890
12	1·0690	25	1·1439	38	1·2172		
13	1·0747	26	1·1496	39	1·2228		

Sulphates—*continued.*

Chromic Sulphate, $Cr_2(SO_4)_3$ + Aq at 15° C. (Gerlach).

Per cent. of Anhy. Salt.	Per cent. of Salt, 18aq.	Sp. Gr.	
		Green Modif.	Violet Modif.
3·779	6·897	1·034	1·038
7·283	13·291	1·068	1·075
10·542	19·238	1·102	1·110
13·579	24·779	1·136	1·145
16·416	29·957	1·168	1·178
19·072	34·804	1·201	1·211
28·202	51·464	1·316	1·337
37·075	67·657	1·445	
43·996	80·287	1·556	

Copper Sulphate, $CuSO_4$ + Aq at 18° C. (Schiff; cal. Gerlach).
Per cent. = Per cent. of $CuSO_4$ 5 aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·0093	9	1·0582	17	1·1135	25	1·1738
2	1·0126	10	1·0649	18	1·1208	26	1·1817
3	1·0190	11	1·0716	19	1·1281	27	1·1898
4	1·0254	12	1·0785	20	1·1354	28	1·1980
5	1·0319	13	1·0854	21	1·1427	29	1·2063
6	1·0384	14	1·0923	22	1·1501	30	1·2146
7	1·0450	15	1·0993	23	1·1585		
8	1·0516	16	1·1063	24	1·1659		

Sulphates—*continued.*

FERRIC SULPHATE, $Fe_2(SO_4)_3$ + Aq. at 17·5° (Franz).

Per cent. of $Fe_2(SO_4)_3$.	Sp. Gr.	Per cent. of $Fe_2(SO_4)_3$.	Sp. Gr.	Per cent. of $Fe_2(SO_4)_3$.	Sp. Gr.	Per cent. of $Fe_2(SO_4)_3$.	Sp. Gr.
5	1·0426	20	1·1825	35	1·3782	50	1·6148
10	1·0854	25	1·2426	40	1·4506	55	1·7050
15	1·1324	30	1·3090	45	1·5298	60	1·8006

FERRO-AMMONIUM SULPHATE, $Fe(NH_4)(SO_4)_2$ + Aq at 16·5° C. (Schiff).

Per cent. of Anhy. Salt.	Per cent. of Salt, 6aq.	Sp. Gr.	Per cent. of Anhy. Salt.	Per cent. of Salt, 6aq.	Sp. Gr.
4·253	5·87	1·0351	12·751	17·60	1·1083
6·376	8·80	1·0529	19·126	26·40	1·1666
8·506	11·74	1·0711			

FERROUS SULPHATE, $FeSO_4$ + Aq at 15° C. (Gerlach).
Per cent. = Per cent. of $FeSO_4$ 7 aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·005	11	1·059	21	1·118	31	1·180
2	1·011	12	1·065	22	1·125	32	1·187
3	1·016	13	1·071	23	1·131	33	1·193
4	1·021	14	1·077	24	1·137	34	1·200
5	1·027	15	1·082	25	1·143	35	1·206
6	1·032	16	1·088	26	1·149	36	1·213
7	1·037	17	1·094	27	1·155	37	1·219
8	1·043	18	1·100	28	1·161	38	1·226
9	1·048	19	1·106	29	1·168	39	1·232
10	1·054	20	1·112	30	1·174	40	1·239

Sulphates—*continued.*

MAGNESIUM SULPHATE + Aq at 15° C. (Gerlach).

Per cent. of $MgSO_4$.	Sp. Gr.	Per cent. of $MgSO_4$.	Sp. Gr.	Per cent. of $MgSO_4$.	Sp. Gr.	Per cent. of $MgSO_4$.	Sp. Gr.
1	1·0103	8	1·0838	15	1·1622	22	1·2472
2	1·0206	9	1·0945	16	1·1742	23	1·2597
3	1·0309	10	1·1053	17	1·1862	24	1·2722
4	1·0412	11	1·1167	18	1·1982	25	1·2848
5	1·0515	12	1·1281	19	1·2101	25·248	1·2880
6	1·0623	13	1·1394	20	1·2221		
7	1·0730	14	1·1508	21	1·2346		

MANGANOUS SULPHATE, $MnSO_4 + Aq$ at 15° C. (Gerlach).

Per cent. = Per cent. of $MnSO_4,4aq$.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·006	15	1·100	29	1·208	43	1·331
2	1·013	16	1·106	30	1·215	44	1·340
3	1·020	17	1·114	31	1·224	45	1·350
4	1·025	18	1·121	32	1·231	46	1·360
5	1·032	19	1·129	33	1·244	47	1·370
6	1·038	20	1·136	34	1·250	48	1·380
7	1·044	21	1·144	35	1·258	49	1·389
8	1·050	22	1·150	36	1·268	50	1·399
9	1·056	23	1·160	37	1·276	51	1·410
10	1·065	24	1·166	38	1·285	52	1·420
11	1·072	25	1·175	39	1·295	53	1·430
12	1·079	26	1·183	40	1·304	54	1·440
13	1·085	27	1·190	41	1·313	55	1·451
14	1·093	28	1·200	42	1·322		

POTASSIUM ALUMINIUM SULPHATE, $KAl(SO_4)_2 + Aq$ at 17·5° C. (Gerlach).

Per cent. of Salt, 12aq.	Per cent. of Anhy. Salt.	Sp. Gr.	Per cent. of Salt, 12aq.	Per cent. of Anhy. Salt.	Sp. Gr.
1	0·5448	1·0049	6	3·6291	1·0310
2	1·0896	1·0100	8	4·3584	1·0415
3	1·6336	1·0152	10	5·4485	1·0523
4	2·1792	1·0205	12	6·5376	1·0635
5	2·7242	1·0258			

Sulphates—*continued.*

POTASSIUM CHROMIUM SULPHATE, $KCr(SO_4)_2 + Aq$ at 17·5° C. (Franz).

Per cent. of Salt, 12aq.	Sp. Gr.	Per cent. of Salt, 12aq.	Sp. Gr.	Per cent. of Salt, 12aq.	Sp. Gr.	Per cent. of Salt, 12aq.	Sp. Gr.
5	1·0174	20	1·0746	40	1·1896	60	1·4566
10	1·0342	30	1·1274	50	1·2894	70	1·6362

POTASSIUM SULPHATE, $K_2SO_4 + Aq$ at 15° (Gerlach).

Per cent. of K_2SO_4.	Sp. Gr.	Per cent. of K_2SO_4.	Sp. Gr.	Per cent. of K_2SO_4.	Sp. Gr.	Per cent. of K_2SO_4.	Sp. Gr.
1	1·0082	4	1·0328	7	1·0579	9·92	1·0830
2	1·0163	5	1·0410	8	1·0664	satd.	
3	1·0245	6	1·0495	9	1·0750		

SODIUM SULPHATE, $Na_2SO_4 + Aq$ at 15°C. (Gerlach).

Per cent.	Sp. Gr. of Na_2SO_4.	Sp. Gr. of Na_2SO_4, 10aq.	Per cent.	Sp. Gr. of Na_2SO_4, 10aq.	Per cent.	Sp. Gr. of Na_2SO_4, 10aq.
1	1·0091	1·004	11	1·044	21	1·086
2	1·0182	1·008	12	1·047	22	1·090
3	1·0274	1·013	13	1·052	23	1·094
4	1·0365	1·016	14	1·056	24	1·098
5	1·0457	1·020	15	1·060	25	1·103
6	1·0550	1·024	16	1·064	26	1·107
7	1·0644	1·028	17	1·069	27	1·111
8	1·0737	1·032	18	1·073	28	1·116
9	1·0832	1·036	19	1·077	29	1·120
10	1·0927	1·040	20	1·082	30	1·125

Sulphates—*continued.*

ZINC SULPHATE, $ZnSO_4$ + Aq at 15° C. (Gerlach).

Per cent. = Per cent. of $ZnSO_4$,7aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·006	16	1·097	31	1·200	46	1·320
2	1·013	17	1·103	32	1·209	47	1·330
3	1·019	18	1·110	33	1·216	48	1·337
4	1·024	19	1·116	34	1·224	49	1·346
5	1·029	20	1·124	35	1·231	50	1·353
6	1·035	21	1·130	36	1·240	51	1·362
7	1·041	22	1·137	37	1·246	52	1·370
8	1·047	23	1·143	38	1·255	53	1·380
9	1·053	24	1·150	39	1·263	54	1·390
10	1·059	25	1·157	40	1·271	55	1·399
11	1·066	26	1·164	41	1·280	56	1·408
12	1·073	27	1·171	42	1·288	57	1·416
13	1·079	28	1·179	43	1·295	58	1·425
14	1·085	29	1·185	44	1·304	59	1·435
15	1·090	30	1·193	45	1·310	60	1·445

Sulphocarbonate.

POTASSIUM SULPHOCARBONATE, K_2CS_3 + Aq at 15° C. (Delachanal).

Per cent. of CS_2.	Per cent. of K_2CS_3.	Sp. Gr.	Per cent. of CS_2.	Per cent. of K_2CS_3.	Sp. Gr.
2·12	5·2	1·036	17·70	43·5	1·332
4·37	10·7	1·075	18·85	46·2	1·357
6·57	16·1	1·116	19·95	48·9	1·383
8·98	22·0	1·161	21·13	51·8	1·410
11·63	28·5	1·209	23·01	56·4	1·453
14·28	35·0	1·262	25·99	63·7	1·530
15·42	37·8	1·284	27·74	68·0	1·580
16·60	40·7	1·308			

Sulphur in CS_2 at 15° C. (Macagno).

Per cent of S.	Sp. Gr.	Per cent. of S.	Sp. Gr.	Per cent. of S.	Sp. Gr.	Per cent. of S.	Sp. Gr.
0	1·271	7·5	1·302	15·0	1·333	23·0	1·364
0·2	1·272	7·8	1·303	15·2	1·334	23·2	1·365
0·4	1·273	8·0	1·304	15·4	1·335	23·6	1·366
0·6	1·274	8·2	1·305	15·6	1·336	24·0	1·367
0·9	1·275	8·5	1·306	15·9	1·337	24·3	1·368
1·2	1·276	8·7	1·307	16·1	1·338	24·8	1·369
1·4	1·277	8·9	1·308	16·4	1·339	25·1	1·370
1·6	1·278	9·2	1·309	16·6	1·340	25·6	1·371
1·9	1·279	9·4	1·310	16·9	1·341	26·0	1·372
2·1	1·280	9·7	1·311	17·1	1·342	26·5	1·373
2·4	1·281	9·9	1·312	17·4	1·343	26·9	1·374
2·6	1·282	10·2	1·313	17·6	1·344	27·4	1·375
2·9	1·283	10·4	1·314	17·9	1·345	28·1	1·376
3·1	1·284	10·6	1·315	18·1	1·346	28·5	1·377
3·4	1·285	10·9	1·316	18·4	1·347	29·0	1·378
3·6	1·286	11·1	1·317	18·6	1·348	29·7	1·379
3·9	1·287	11·3	1·318	18·9	1·349	30·2	1·380
4·1	1·288	11·6	1·319	19·0	1·350	30·8	1·381
4·4	1·289	11·8	1·320	19·3	1·351	31·4	1·382
4·6	1·290	12·1	1·321	19·6	1·352	31·9	1·383
4·8	1·291	12·3	1·322	19·9	1·353	32·6	1·384
5·0	1·292	12·6	1·323	20·1	1·354	33·2	1·385
5·3	1·293	12·8	1·324	20·4	1·355	33·8	1·386
5·6	1·294	13·1	1·325	20·6	1·356	34·5	1·387
5·8	1·295	13·3	1·326	21·0	1·357	35·2	1·388
6·0	1·296	13·5	1·327	21·2	1·358	36·1	1·389
6·3	1·297	13·8	1·328	21·5	1·359	36·7	1·390
6·5	1·298	14·0	1·329	21·8	1·360	37·2	1·391
6·7	1·299	14·2	1·330	22·1	1·361	(saturated)	
7·0	1·300	14·5	1·331	22·3	1·362		
7·2	1·301	14·7	1·332	22·7	1·363		

Sulphur Dioxide, $SO_2 + Aq$ at –° C. (Giles and Schearer).

Per cent. of SO_2.	Temp.	Sp. Gr.	Per cent. of SO_2.	Temp.	Sp. Gr.	Per cent. of SO_2.	Temp.	Sp. Gr.
0·99	15·5°	1·0051	5·89	15·5°	1·0297	10·75	15·5°	1·0541
2·05	,,	1·0102	7·01	,,	1·0353	11·65	12·5°	1·0597
2·87	,,	1·0148	8·08	,,	1·0399	13·09	11·0°	1·0668
4·04	,,	1·0204	8·68	,,	1·0438			
4·99	,,	1·0252	9·80	,,	1·0492			

Sulphuric Acid, $H_2SO_4 + Aq$ at $\frac{15^\circ}{4}$ C. (Lunge and Isler).

To convert percentage by wt. into g. per l.:

$$\text{Per cent.} \times \text{sp. gr.} \times 10 = \text{g. per l.},$$

$$\frac{\text{Per cent.} \times \text{sp. gr.}}{100} = \text{kg. per l.}$$

Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent. by wt. of SO_3.	Per cent. by wt. of H_2SO_4.	Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent. by wt. of SO_3.	Per cent. by wt. of H_2SO_4.	Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent. by wt. of SO_3.	Per cent. by wt. of H_2SO_4.
1·000	0·07	0·09	1·145	16·54	20·26	1·290	31·04	38·03
1·005	0·68	0·83	1·150	17·07	20·91	1·295	31·52	38·61
1·010	1·28	1·57	1·155	17·59	21·55	1·300	31·99	39·19
1·015	1·88	2·30	1·160	18·11	22·19	1·305	32·46	39·77
1·020	2·47	3·03	1·165	18·64	22·83	1·310	32·94	40·35
1·025	3·07	3·76	1·170	19·16	23·47	1·315	33·41	40·93
1·030	3·67	4·49	1·175	19·69	24·12	1·320	33·88	41·50
1·035	4·27	5·23	1·180	20·21	24·76	1·325	34·35	42·08
1·040	4·87	5·96	1·185	20·73	25·40	1·330	34·80	42·66
1·045	5·45	6·67	1·190	21·26	26·04	1·335	35·27	43·20
1·050	6·02	7·37	1·195	21·78	26·68	1·340	35·71	43·74
1·055	6·59	8·07	1·200	22·30	27·32	1·345	36·14	44·28
1·060	7·16	8·77	1·205	22·82	27·95	1·350	36·58	44·82
1·065	7·73	9·47	1·210	23·33	28·58	1·355	37·02	45·37
1·070	8·32	10·19	1·215	23·84	29·21	1·360	37·45	45·88
1·075	8·90	10·90	1·220	24·36	29·84	1·365	37·89	46·41
1·080	9·47	11·60	1·225	24·88	30·48	1·370	38·32	46·94
1·085	10·04	12·30	1·230	25·39	31·11	1·375	38·75	47·47
1·090	10·60	12·99	1·235	25·88	31·70	1·380	39·18	48·00
1·095	11·16	13·67	1·240	26·35	32·28	1·385	39·62	48·53
1·100	11·71	14·35	1·245	26·83	32·86	1·390	40·05	49·06
1·105	12·27	15·03	1·250	27·29	33·43	1·395	40·48	49·59
1·110	12·82	15·71	1·255	27·66	34·00	1·400	40·91	50·11
1·115	13·36	16·36	1·260	28·22	34·57	1·405	41·33	50·63
1·120	13·89	17·01	1·265	28·69	35·14	1·410	41·71	51·15
1·125	14·42	17·66	1·270	29·15	35·71	1·415	42·17	51·66
1·130	14·95	18·31	1·275	29·62	36·29	1·420	42·57	52·15
1·135	15·48	18·96	1·280	30·10	36·87	1·425	42·96	52·63
1·140	16·01	19·61	1·285	30·57	37·45	1·430	43·36	53·11

Sulphuric Acid—*continued.*

Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent. by wt. of SO_3.	Per cent. by wt. of H_2SO_4.	Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent. by wt. of SO_3.	Per cent. by wt. of H_2SO_4.	Sp. Gr. $\frac{15^\circ}{4}$ *in vacuo.*	Per cent by wt. of SO_3.	Per cent. by wt. of H_2SO_4.
1·435	43·75	53·59	1·615	57·05	69·89	1·795	70·45	86·30
1·440	44·14	54·07	1·620	57·40	70·32	1·800	70·94	86·90
1·445	44·53	54·55	1·625	57·75	70·74	1·805	71·50	87·60
1·450	44·92	55·03	1·630	58·09	71·16	1·810	72·08	88·30
1·455	45·31	55·50	1·635	58·43	71·57	1·815	72·69	89·05
1·460	45·69	55·97	1·640	58·77	71·99	1·820	73·51	90·05
1·465	46·07	56·43	1·645	59·10	72·40	1·821	73·63	90·20
1·470	46·45	56·90	1·650	59·45	72·82	1·822	73·80	90·40
1·475	46·83	57·37	1·655	59·78	73·23	1·823	73·98	90·60
1·480	47·21	57·83	1·660	60·11	73·64	1·824	74·12	90·80
1·485	47·57	58·28	1·665	60·46	74·07	1·825	74·29	91·20
1·490	47·95	58·74	1·670	60·82	74·51	1·826	74·49	91·25
1·495	48·34	59·22	1·675	61·20	74·97	1·827	74·69	91·50
1·500	48·73	59·70	1·680	61·57	75·42	1·828	74·86	91·70
1·505	49·12	60·18	1·685	61·93	75·86	1·829	75·03	91·90
1·510	49·51	60·65	1·690	62·29	76·30	1·830	75·19	92·10
1·515	49·89	61·12	1·695	62·64	76·73	1·831	75·35	92·30
1·520	50·28	61·59	1·700	63·00	77·17	1·832	75·53	92·52
1·525	50·66	62·06	1·705	63·35	77·60	1·833	75·72	92·75
1·530	51·04	62·53	1·710	63·70	78·04	1·834	75·96	93·05
1·535	51·43	63·00	1·715	64·07	78·48	1·835	76·27	93·43
1·540	51·78	63·43	1·720	64·43	78·92	1·836	76·57	93·80
1·545	52·12	63·85	1·725	64·78	79·36	1·837	76·90	94·20
1·550	52·46	64·26	1·730	65·14	79·80	1·838	77·23	94·60
1·555	52·79	64·67	1·735	65·50	80·24	1·839	77·55	95·00
1·560	53·12	65·08	1·740	65·86	80·68	1·840	78·04	95·60
1·565	53·46	65·49	1·745	66·22	81·12	1·8405	78·33	95·95
1·570	53·80	65·90	1·750	66·58	81·56	1·8410	79·19	97·00
1·575	54·13	66·30	1·755	66·94	82·00	1·8415	79·76	97·70
1·580	54·46	66·71	1·760	67·30	82·44	1·8410	80·16	98·20
1·585	54·80	67·13	1·765	67·65	82·88	1·8405	80·57	98·70
1·590	55·18	67·59	1·770	68·02	83·32	1·8400	80·98	99·20
1·595	55·55	68·05	1·775	68·49	83·90	1·8395	81·18	99·45
1·600	55·93	68·51	1·780	68·98	84·50	1·8390	81·39	99·70
1·605	56·30	68·97	1·785	69·47	85·10	1·8385	81·59	99·95
1·610	56·68	69·43	1·790	69·96	85·70			

Sulphuric Acid—*continued.*

Anthon's Table by which to prepare Sulphuric Acid (Oil of Vitriol) of any Strength by mixing the Acid of 1·86 Specific Gravity with Water.

100 parts of Water at 15° to 20° being mixed with parts of Sulphuric Acid of 1·86 sp. gr.	Give an Acid of Specific Gravity.	100 parts of Water at 15° to 20° being mixed with parts of Sulphuric Acid of 1·86 sp. gr.	Give an Acid of Specific Gravity.	100 parts of Water at 15° to 20° being mixed with parts of Sulphuric Acid of 1·86 sp. gr.	Give an Acid of Specific Gravity.
1	1·009	130	1·456	370	1·723
2	1·015	140	1·473	380	1·727
5	1·035	150	1·490	390	1·730
10	1·060	160	1·510	400	1·733
15	1·090	170	1·530	410	1·737
20	1·113	180	1·543	420	1·740
25	1·140	190	1·556	430	1·743
30	1·165	200	1·568	440	1·746
35	1·187	210	1·580	450	1·750
40	1·210	220	1·593	460	1·754
45	1·229	230	1·606	470	1·757
50	1·248	240	1·620	480	1·760
55	1·265	250	1·630	490	1·763
60	1·280	260	1·640	500	1·766
65	1·297	270	1·648	510	1·768
70	1·312	280	1·654	520	1·770
75	1·326	290	1·667	530	1·772
80	1·340	300	1·678	540	1·774
85	1·357	310	1·689	550	1·776
90	1·372	320	1·700	560	1·777
95	1·386	330	1·705	580	1·778
100	1·398	340	1·710	590	1·780
110	1·420	350	1·714	600	1·782
120	1·438	360	1·719		

Sulphuric Acid—*continued.*

Fuming or Nordhausen (Lunge).

Density at					Per cent. of SO_3.
15° C.	20° C.	25° C.	30° C.	35° C.	
1·8417	1·8371	1·8323	1·8287	1·8240	76·67
1·8727	1·8378	1·8333	1·8295	1·8249	77·49
1·8428	1·8388	1·8351	1·8302	1·8255	78·34
1·8437	1·8390	1·8346	1·8300	1·8257	79·04
1·8427	1·8386	1·8351	1·8297	1·8250	79·99
1·8420	1·8372	1·8326	1·8281	1·8234	80·46
1·8398	1·8350	1·8305	1·8263	1·8218	80·94
1·8446	1·8400	1·8353	1·8307	1·8262	81·37
1·8509	1·8466	1·8418	1·8371	1·8324	81·91
1·8571	1·8522	1·8476	1·8432	1·8385	82·17
1·8697	1·8647	1·8595	1·8545	1·8498	82·94
1·8790	1·8742	1·8687	1·8640	1·8592	83·25
1·8875	1·8823	1·8767	1·8713	1·8661	83·84
1·8942	1·8888	1·8833	1·8775	1·8722	84·12
1·8990	1·8940	1·8890	1·8830	1·8772	84·33
1·9034	1·8984	1·8930	1·8874	1·8820	84·67
1·9072	1·9021	1·8950	1·8900	1·8845	84·82
1·9095	1·9042	1·8986	1·8932	1·8866	84·99
1·9121	1·9053	1·8993	1·8978	1·8892	85·14
1·9250	1·9193	1·9135	1·9082	1·9023	85·54
1·9290	1·9236	1·9183	1·9129	1·9073	85·68
1·9368	1·9310	1·9250	1·9187	1·9122	85·88
1·9447	1·9392	1·9334	1·9279	1·9222	86·51
1·9520	1·9465	1·9402	1·9338	1·9278	86·72
1·9584	1·9528	1·9466	1·9406	1·9340	87·03
1·9632	1·9573	1·9518	1·9457	1·9398	87·46
cryst.	cryst.	1·9740	1·9666	1·9740	88·00

The specific gravity is an uncertain guide for the percentage of Nordhausen acid, and altogether fails as such for the strengths just below the monohydrate. The table was not made for chemically pure acids, but for commercial acid, and is only intended as a rough guide in the works.

Tannic Acid (Tannin), at 15° C. (Trammer).

TABLE SHOWING THE STRENGTH OF SOLUTIONS OF TANNIC ACID BY SPECIFIC GRAVITY AT 15° C.

Per cent. of Tannin.	Sp. Gr.	Per cent. of Tannin.	Sp. Gr.	Per cent. of Tannin.	Sp. Gr.
·1	1·0004	2·1	1·0084	4·1	1·0164
·2	1·0008	2·2	1·0088	4·2	1·0168
·3	1·0012	2·3	1·0092	4·3	1·0172
·4	1·0016	2·4	1·0096	4·4	1·0176
·5	1·0020	2·5	1·0100	4·5	1 0180
·6	1·0024	2·6	1·0104	4·6	1·0184
·7	1·0028	2·7	1·0108	4·7	1·0188
·8	1·0032	2·8	1·0112	4·8	1·0192
·9	1·0036	2·9	1·0116	4·9	1·0196
1·0	1·0040	3·0	1·0120	5·0	1·0200
1·1	1·0044	3·1	1·0124	6·0	1·0242
1·2	1·0048	3·2	1·0128	8·0	1·0324
1·3	1·0052	3·3	1·0132	10·0	1·0406
1·4	1·0056	3·4	1·0136	12·0	1·0489
1·5	1·0060	3·5	1·0140	14·0	1·0572
1·6	1·0064	3·6	1·0144	16·0	1·0656
1·7	1·0068	3·7	1·0148	18·0	1·0740
1·8	1·0072	3·8	1·0152	20·0	1·0824
1·9	1·0076	3·9	1·0156		
2·0	1·0080	4·0	1·0160		

Tartaric Acid, $C_4H_6O_6$ + Aq at 15° C. (Gerlach).

TABLE SHOWING THE STRENGTH OF SOLUTIONS OF TARTARIC ACID BY SPECIFIC GRAVITY AT 15° C.

Per cent of $C_4H_6O_6$.	Sp. Gr.	Per cent. of $C_4H_6O_6$.	Sp. Gr.	Per cent. of $C_4H_6O_6$.	Sp. Gr.
1	1·0045	21	1·1020	40	1·2078
2	1·0090	22	1·1072	41	1·2138
3	1·0136	23	1·1124	42	1·2198
4	1·0179	24	1·1175	43	1·2259
5	1·0224	25	1·1227	44	1·2317
6	1·0273	26	1·1282	45	1·2377
7	1·0322	27	1·1338	46	1·2441
8	1·0371	28	1·1393	47	1·2504
9	1·0420	29	1·1449	48	1·2568
10	1·0469	30	1·1505	49	1·2632
11	1·0517	31	1·1560	50	1·2696
12	1·0565	32	1·1615	51	1·2762
13	1·0613	33	1·1670	52	1·2828
14	1·0661	34	1·1726	53	1·2894
15	1·0709	35	1·1781	54	1·2961
16	1·0761	36	1·1840	55	1·3027
17	1·0813	37	1·1900	56	1·3093
18	1·0865	38	1·1959	57	1·3159
19	1·0917	39	1·2019	57·9	1·3220
20	1·0969				

Tartrates.

POTASSIUM SODIUM TARTRATE, $NaKC_4H_4O_6$ + Aq at 17·5° C. (Gerlach).

Per cent. of Salt, 4aq.	Per cent. of Anhy.	Sp. Gr.	Per cent. of Salt, 4aq.	Per cent. of Anhy.	Sp. Gr.
0	0	1·000	30	22·344	1·1620
10	7·448	1·0510	40	29·729	1·2230
20	14·896	1·1050	50	37·240	1·2890

Thiosulphate.

SODIUM THIOSULPHATE, $Na_2S_2O_3$ + Aq at 19° (Schiff).
Per cent = Per cent. of $Na_2S_2O_3$, 5aq.

Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.	Per cent.	Sp. Gr.
1	1·0052	14	1·0751	27	1·1499	40	1·2297
2	1·0105	15	1·0807	28	1·1558	41	1·2362
3	1·0158	16	1·0863	29	1·1617	42	1·2427
4	1·0211	17	1·0919	30	1·1676	43	1·2492
5	1·0264	18	1·0975	31	1·1738	44	1·2558
6	1·0317	19	1·1031	32	1·1800	45	1·2624
7	1·0370	20	1·1087	33	1·1862	46	1·2690
8	1·0423	21	1·1145	34	1·1924	47	1·2756
9	1·0476	22	1·1204	35	1·1986	48	1·2822
10	1·0529	23	1·1263	36	1·2048	49	1·2888
11	1·0584	24	1·1322	37	1·2110	50	1·2954
12	1·0639	25	1·1381	38	1·2172		
13	1·0695	26	1·1440	39	1·2234		

Tin.

Stannic Chloride, $SnCl_4$ + Aq at 15° C. (Gerlach).

Per cent. of $SnCl_4$, 5aq.	Sp. Gr.	Per cent. of $SnCl_4$, 5aq.	Sp. Gr.	Per cent. of $SnCl_4$, 5aq.	Sp. Gr.	Per cent. of $SnCl_4$, 5aq.	Sp. Gr.
2	1·012	26	1·165	50	1·366	74	1·641
4	1·024	28	1·180	52	1·386	76	1·669
6	1·036	30	1·195	54	1·406	78	1·698
8	1·048	32	1·210	56	1·426	80	1·727
10	1·059	34	1·226	58	1·447	82	1·759
12	1·072	36	1·242	60	1·468	84	1·791
14	1·084	38	1·259	62	1·491	86	1·824
16	1·097	40	1·276	64	1·514	88	1·859
18	1·110	42	1·293	66	1·538	90	1·894
20	1·124	44	1·310	68	1·563	92	1·932
22	1·137	46	1·329	70	1·587	94	1·969
24	1·151	48	1·347	72	1·614	95	1·988

Stannous Chloride, $SnCl_2$ + Aq at 15° C. (Gerlach).

Per cent. of $SnCl_2$, 2aq.	Sp. Gr.	Per cent. of $SnCl_2$, 2aq.	Sp. Gr.	Per cent. of $SnCl_2$, 2aq.	Sp. Gr.	Per cent. of $SnCl_2$, 2aq.	Sp. Gr.
2	1·013	22	1·161	42	1·352	62	1·613
4	1·026	24	1·177	44	1·374	64	1·644
6	1·040	26	1·194	46	1·397	66	1·677
8	1·054	28	1·212	48	1·421	68	1·711
10	1·068	30	1·230	50	1·445	70	1·745
12	1·083	32	1·249	52	1·471	72	1·783
14	1·097	34	1·268	54	1·497	74	1·821
16	1·113	36	1·288	56	1·525	75	1·840
18	1·128	38	1·309	58	1·554		
20	1·144	40	1·330	60	1·582		

Tungstic Acid, HWO_4 + Aq at ° C.
(Schaller; Mendelejeff).

Per cent. of WO_3.	Sp. Gr. $\frac{17\cdot5}{17\cdot5}$	Sp. Gr. $\frac{15}{4}$	Per cent. of WO_3.	Sp. Gr. $\frac{17\cdot5}{17\cdot5}$	Sp. Gr. $\frac{15}{4}$
0	1·0000	·999	30	1·3660	1·366
5	1·0469	1·047	35	1·4540	1·458
10	1·0980	1·098	40	1·5527	1·555
15	1·1544	1·153	45	1·6630	1·581
20	1·2172	1·214	50	1·7860	
25	1·2873	1·285			

Zinc Bromide, $ZnBr_2$ + Aq at 19·5° C.
(Kremers; cal. Gerlach).

Per cent. of $ZnBr_2$.	Sp. Gr.	Per cent. of $ZnBr_2$.	Sp. Gr.	Per cent. of $ZnBr_2$.	Sp. Gr.	Per cent. of $ZnBr_2$.	Sp. Gr.
5	1·045	20	1·204	35	1·400	50	1·650
10	1·093	25	1·265	40	1·475	55	1·755
15	1·196	30	1·330	45	1·560	60	1·875

Zinc Chloride, $ZnCl_2$ + Aq at 19·5° C.
(Kremers; cal. Gerlach).

Per cent. of $ZnCl_2$.	Sp. Gr.	Per cent. of $ZnCl_2$.	Sp. Gr.	Per cent. of $ZnCl_2$.	Sp. Gr.	Per cent. of $ZnCl_2$.	Sp. Gr.
1	1·010	20	1·186	40	1·420	60	1·740
5	1·045	25	1·238	45	1·488		
10	1·091	30	1·291	50	1·566		
15	1·137	35	1·352	55	1·650		

Zinc Iodide, ZnI_2+Aq at 19·5° C. (Kremers; cal. Gerlach).

Per cent. of ZnI_2.	Sp. Gr.	Per cent. of ZnI_2.	Sp. Gr.	Per cent. of ZnI_2.	Sp. Gr.	Per cent. of ZnI_2.	Sp. Gr.
5	1·045	20	1·196	35	1·390	50	1·650
10	1·091	25	1·255	40	1·420	55	1·754
15	1·140	30	1·368	45	1·560	60	1·875

To Dilute a Solution to a Lower Gravity.

If (D) = sp. gr. of a solution of volume (v) which it is required to dilute to the sp. gr. (d') by means of a solution of sp. gr. (d), then the volume (x) of the solution used for diluting is

$$x = \frac{v\,(D - d')}{d' - d} \text{ and } d' = \frac{v\,D + x\,d}{v + x}.$$

It is assumed that no contraction takes place. Sp. gr. of water = 1.

SECTION VI.—TABLE OF MELTING AND BOILING POINTS, SPECIFIC GRAVITY, SOLUBILITY, AND SOME OTHER PHYSICAL PROPERTIES.

For contractions used in this Table, *see* p. 278.

Abietic Acid. $C_{44}H_{64}O_5$. [139°], [165°]. [A], [E], [B], [AA], [C], [CS_2].
Acenaphthene. $C_{10}H_6 : C_2H_4$. [95°], [103°], (278° i. V.). [A], [**A** hot].
Acenaphthylene. $C_{10}H_6 : C_2H_2$. [**A**], [**E**], [**B**].
Acetal. $CH_3.CH(OEt)_2$. (102·2°). S.G. $\frac{15}{15}$ ·8319. [W 4·6, 25°). [A], [E].
Acetamide. $CH_3.CO.NH_2$. [83°], (222° cor.). S.G. $\frac{}{4}$ 1·159. [**W**], [A], [E],
Acetanilide. $PhNH.C_2H_3O$. (*Antifebrine*). [114°]. (295°), [W ·34, 14°; 6·59, 102·5°]. [A]. E, B, C.

Acetates. $A' = C_2H_3O_2$. All metallic acetates sol. in W except some basic salts. **AmA′**, [A], [E]. **BaA′$_2$aq**, (A), (E). **CaA′$_2$aq**, [A]. **Cu$_2$A′$_2$**, decomp. by W. **CuA′$_2$aq**, [A], (E). **PbA′$_2$3aq**, [A dil.]; (A absol.), (E). **LiA′2aq**, [A], [E]. **MgA′$_2$4aq**, [**A**]. **MnA′$_2$4aq**, [A]. **HgA′$_2$**, [W 25, 10°), [A with part. decomp.]. **Ni acet.**, (A). **KA′**, [W 229, 13·9°], sol. 3 p. cold A., (E). **NaA′3aq**, [W 26, 6°], [A 2·1, 18°], (A). **MeA′**, (56·3°), (57·5°), S.G. $\frac{15}{15}$ ·9398, [W], [A], [E]. **EtA′**, S.G. $\frac{15}{15}$ ·9253 (77·1°), [W], [A], [E]. **AmA′**, *Normal primary*, (148·4°), S.G. ·8963, (W), [A], [E]; *Iso-primary*, (137°), S.G. ·8837, (W), [A]. **BuA′**, *N. p.*, (124°), S.G. ·9016; *Iso-p.*, (116·5°), S.G. ·8596.

Acetic Acid. $CH_3.CO.OH$. [17·5°], (118·29°). S.G. (sol.) $\frac{0}{0}$ 1·0701; $\frac{15}{4}$ 1·0607; (liq.) $\frac{16}{4}$ 1·0543. H.F.p. 105,290. H.F.v. 104,130. S.H. (0° to 100°) ·497. [W], [A]: Glac. ac. is [E]; (E) if W present. **Anhydride.** $C_4H_6O_3$. (137·8°) at 755 mm. S.G. $\frac{20}{4}$ 1·0816. [W when shaken.]

Acetone. $CH_3.CO.CH_3$. (56·53° cor.). S.G. $\frac{15}{15}$ ·7965. [W], [A], [E].
Acetonitrile. $CH_3.C \vdots N$. (81·6°). S.G. $\frac{15}{}$ ·789. [W], [A].

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Acetoxim. $Me_2C:NOH$. [60°], (135° i. V. at 730 mm.). [**W**], [**A**], [**E**], [B].

Acetyl Chloride. C_2H_3OCl. (50 9° cor.). S.G. $\frac{0}{4}$ 1·1377. Reacts with W.

Acetylene. CH ⋮ CH. S.G. $\frac{16}{\ }$ ·420 (liq.). [W], [A], [CS_2], [CCl_4], [AmHO], [B], [AA].

Aconitic Acid. $C_6H_6O_6$. [186°–187°]. [W 18·6, 13°], [A 80%, 50, 12°].

Aconitine. $C_{33}H_{43}NO_{12}$. [183° cor.]. [W 13], [B or C, 18], [E 1·56], [A 2·7].

Acrolein. $CH_2:CH.CHO$, (52·4°). S.G $\frac{20}{4}$ ·841. [W 2·5], [E].

Acrylic Acid. $CH_2:CH.CO_2H$. [8°], (140). [w].

Adipic Acid. $CO_2H(CH_2)_4CO_2H$. [149°]. [W 1·44, 15°], [W 7·73, 18°], [E ·633, 19°], [A].

Æsculetin. $C_9H_6O_4$. Sol. of —, aq.; [*W*], [*A*], [*E*].

Æsculin. $C_{15}H_{16}O_9$. [204·5–205]. Sol. of —, 2 aq.; [*W*], [W hot], [*A* hot]. [E], [AA].

Æthal. *V.* Cetyl Alcohol.

Agaricin. [*W*], (E), [A].

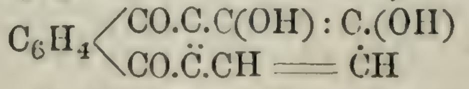
Albumin. [W], (W, after coagultn.), (A), (E). [HCl conc.]. [KHOaq].

Alcohol. EtHO. (78·4°). S.G. $\frac{15}{15}$ ·79503. S.H. ·615 Kopp. S.H. ·6019 (16°–20°). H.F.p. 58,470. H.F.v. 57,020. [w]. *V.* Tab., p. 482 et seq.

Aldehyde (acetic). $CH_3.CHO$. (21°). S.G. $\frac{16}{16}$ ·7876. H.F.v. 48,740. [w], [A], [E].

Aldol. $C_4H_8O_2$. (c. 90° at 20 mm.). S.G. $\frac{16}{\ }$ 1·1094. [w], [A], [E].

Alizarin.



$C_6H_4\left\langle\begin{array}{l}CO.C.C(OH):C.(OH)\\ CO.\ddot{C}.CH = \dot{C}H\end{array}\right.$. [290·] [W, 100°, ·034] [**A**] [**E**].

Allantoin. $C_4H_6N_4O_3$. [W ·62 at 20°; 3·3 at 100°.] [A].

Alloxan. $C_4H_2N_2O_4$aq & 4aq. [**W**], [**A**].

Alloxanic Acid. $C_4H_4N_2O_5$. [A. c. 20], [**W**], [*E*].

Alloxantin. $C_8H_4N_4O_7 3aq$. [*W*], [*A*], [*E*].

Allyl Alcohol. $CH_2:CH.CH_2OH$. [– 50°], (96·6°). S.G. $\frac{15}{15\cdot5}$ ·8576. H.F.p. 31,200. H.F.v. 29,750. [W], [A], [E].

Allylamine. $CH_2:CH.CH_2.NH_2$. (56°), (58°). S.G. $\frac{15}{}$ ·864. [w].

Allyl Bromide. $CH_2:CH.CH_2Br$. (71°). S.G. $\frac{15}{}$ 1·436; $\frac{0}{0}$ 1·459. H.F.p. – 340. H.F.v. – 1500. (W), [A].

Allyl Chloride. $CH_2:CH.CH_2Cl$. (46°). S.G. $\frac{0}{0}$ ·9547; $\frac{20}{4}$ ·9379. H.F.p. 7100. H.F.v. 5940. [A].

Allyl Cyanide. $CH_2:CH.CH_2CN$. (119° cor.). S.G. $\frac{0}{}$ ·8491; $\frac{15}{}$ ·8351.

Allylene. $Me.C:CH$. H.F.p. – 39,950. H.F.v. – 41,530. [**A**], [W]. [E 30, 16°].

Allyl Iodide. $CH_2:CH.CH_2I$. (102·7° i. V.). S.G. $\frac{0}{0}$ 1·8696. (W), [A], [E], with slow decomp.

Allyl Thiocarbimide. $C_3H_5N:CS$. (*Oil of mustard*). (151°). S.G. $\frac{0}{}$ 1·028. [*W*], [**A**], [**E**].

Aluminium Compounds. $\mathbf{Al_2Br_6}$, [c. 90°], (263·3 at 747 mm.), S.G. 2·54, [CS_2], [A], [W]. $\mathbf{Al_2Cl_6}$, (180°–185°), [A], [E], (B). $\mathbf{Al_2I_6}$, [c. 185°], [c. 360°], S.G. 2·63, [W] [CS_2], [A]. The normal nitrate, sulphate, acetate are [W]; most other normal and nearly all basic salts are (W). $\mathbf{AlEt_3}$, (194°), decomp. by W.

Amido-benzene. *V.* Aniline.

Ammonia. NH_3. [– 75° Faraday], (– 38·5° press. less than 760 mm.). S.G. $\frac{0}{0}$ (liq.) ·6234. [W 0°, 1050; 10°, 813; 15°, 727; 20°, 654]. H.F. [N,H_3] 11,890; [N,H_3,Aq] 20,320. [**W**], [**A**], [**E**]. *V.* Tab., p. 177.

Ammonium Compounds. **NH_4Br,** S.G. $\frac{15}{4}$ 2·327, [W 16°, 72], [A S.G. ·806, 15°, 3·1], [E S.G. ·729, ·2]. **NH_4Cl,** S.G. 1·52, [W 10°, 32·8], [A S.G. ·939, 8°, 12·6], V. Tab., p. 178. **NH_4I,** S.G. $\underline{11}$ 2 498, [**W**], [**A**].

Amygdalin. $C_{20}H_{27}NO_{11}3aq$. [200°], [125°–130° after solidfg.] [W 8·5, 12°], (E).

Amyl Alcohols. *Normal*, $CH_3(CH_2)_4OH$, (137° at 740 mm.), S.G. $\frac{0}{0}$ ·8282; *Inactive*, $(CH_3)_2CHCH_2CH_2OH$, (131·5° cor.), S.G. $\frac{15}{15}$ ·8135; *Active*, $CEtMeH.CH_2OH$, (128°). All "Amyl Alcohol" is [A].

Amylamines. *Ordinary*, $(CH_3)_2.CH.CH_2.CH_2.NH_2$, (95°–96°), S.G. $\underline{18}$ ·7503, [W], [A]; *Active*, $(Et)(CH_3)CH.CH_2NH_2$, (96°–97°), S.G. $\frac{0}{4}$ ·7725; *Inactive*, (96°–97°), S.G. $\frac{0}{4}$ ·7678. **Diamylamine,** $(C_5H_{11})_2NH$, (186°–187°), S.G. $\underline{0}$ ·7825, [W]; *Active*, (182°–184°), S.G. $\frac{0}{4}$ ·7878; *Inactive*, (186°–187°), S.G. $\frac{14}{4}$ ·7776. **Triamylamine,** $(C_5H_{11})_3N$, (237°), (W); *Active*, (230°–237°), S.G. $\frac{13}{4}$ ·7964; *Inactive*, (237°), S.G. $\frac{13}{4}$ ·788; *Tertiary*, Me_2EtCNH_2, (77·5°–78°), S.G. $\underline{15\cdot5}$ ·7475.

Amyl Bromides. *Normal*, $Me.(CH_2)_4Br$, (129°), S.G. $\underline{0}$ 1·246; *Inactive*, $Me_2CH.CH_2.CH_2Br$, (120·6° i. V. at 734 mm.), S.G. $\underline{22}$ 1·026; *Iso-*, (118·5° at 756 mm.), S.G. $\frac{15}{15}$ 1·2193; *Active*, (117°–120°), S.G. $\underline{15}$ 1·225. "Amyl Bromide" is (A), [A], [E].

Amyl Chlorides. *Normal*, $Me(CH_2)_4Cl$, (106°), S.G. $\underline{20}$ ·873; *Inactive*, $Me_2CH.CH_2.CH_2Cl$, (99·8°–100·5°), S.G. $\underline{20}$ ·870; *Iso-*, (99·5°), S.G. $\frac{15}{15}$ ·8801; *Active*, $CH_3.CH_2.CH(CH_3).CH_2Cl$, (99°), S.G. $\underline{15}$ ·886.

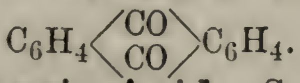
Amylenes. *n-*, Propyl-ethylene, $CH_3.CH_2CH_2CH:CH_2$, (40°), Iso-propyl-ethylene, $Me_2CH.CH:CH_2$, (21°); *s-*, Methyl-ethyl-ethylene, $Me.CH:CH.Et$, (36°); *u-*, Methyl-ethyl-ethylene, $EtC.Me:CH_2$, (32°), S.G. $\underline{0}$ ·670, Trimethyl-ethylene, $Me_2C:CH.Me$, (36°), S.G. $\frac{15}{15}$ ·6704. **Iso-amylene,** (36°), S.G. $\frac{0\cdot9}{4}$ ·661. **Diamylene,** $C_{10}H_{20}$, (156°), S.G. $\frac{10}{4}$ ·780. **Triamylene,** $C_{15}H_{30}$, (248°), S.G. ·871.

Amyl Iodides. *Normal*, $Me(CH_2)_4I$, (156° cor.), S.G. ^{0} 1·544; *Iso-*, (148°), S.G. $\frac{15}{15}$ 1·510; *Active*, $EtCHMe.CH_2I$, (144°–145°), S.G. $\frac{16}{16}$ 1·5425. "Amyl Iodide" is [*W*], [A], [E].

Angelic Acid. $CH_2:CH.CH(CH_3).CO_2H$. [45°], (185° i. V.). [*W*], [**W** hot], [**A**], [**E**].

Aniline. $C_6H_5NH_2$. [– 8°], (185° cor.). S.G. $\frac{15}{15}$ 1·0242. [W 5, c. 15°]. [MOST SOLVENTS.]

Anthracene. $C_{14}H_{10}$. [213°], (c. 360°). [E 1·17, 15°], [HOAc ·44, 15°], [B 1·17, 15°], [A ·08, 16°], [A S.G. ·84, 46, 15°]. [Oil turp.] (W).

Anthraquinone.  $C_6H_4\left\langle\begin{matrix}CO\\CO\end{matrix}\right\rangle C_6H_4$. [273°]. (W), [A ·05, 18°], [*B*] (W). **Anthraquinone Sulphuric Acid.** $C_{14}H_8SO_5$. [**W**], [**A**], [*E*], [H_2SO_4].

Antimony Compounds. **$SbBr_3$**, [90°–94°], (275°–280°), S.G. ^{23} 4·148, decomp. W. **$SbCl_3$**, [73·2°], (223·5°), [W; decomp. by excess], [A], [CS_2 hot]. **$SbCl_5$**, [– 6°], S.G. $\frac{20}{20}$ 2·346, [very little W, decomp. more W]. **SbI_3**, [167°], (401° at 760 mm.), S.G. (hexag.) $^{24°}$ 4·848; (monocl.) $^{24°}$ 4·768, [CS_2 boilg.], [B. boilg.], [*C*], [HIAq], decomp. W, [A, E, with partial decomp.]. **Sb_4O_6**, S.G. trimet. 5·5–5·6, octah. 5·1–5·2, [*W*], [Glycerin], (HNO_3Aq), (H_2SO_4Aq), [HClAq], [Tartaric acid], [hot KOHAq], [hot NaOHAq]. **Sb_2O_5**, S.G. 3·78, (W), [conc. HClAq], [conc. *KOHAq*]. **Sb_2O_4**, S.G. 4·047 (Aq), [*Acids*].

Antipyrine. Syn. Phenyl-dimethyl-pyrazolone. $C_{11}H_{12}N_2O$. [113°]. [W]. [Toluene].

Apiol. $C_{12}H_{14}O_4$. [30°], (c. 300°). (*W*), [A]. [**E**], [**C**].

Apo-. *V.* letter following this prefix.

Arabic Acid. $C_{12}H_{22}O_{11}$; *n* $C_6H_{10}O_5$. [W], [*A*].

Arbutin. $C_{12}H_{16}O_7\frac{1}{2}aq$. [166°]. [**W** boil.], [**A**], [*E*].

Arsenic Compounds. **$AsBr_3$**, [20°–25°], (220°), S.G. 3·66, decomp. Aq. **$AsCl_3$**, [below 29°], (130·2°), S.G. $\frac{0}{4}$ 2·205, decomp. Aq, [A], [E]. **AsI_3**, (394°–414°), S.G. 4·39, [A], [E], [B], decomp. Aq. **AsI_2**, decomp. Aq. **As_4O_6**, Amorph., octahed., trimetric., [W], [*A*], (E). **As_2O_5**, S.G. 3·73, [Aq forming H_3AsO_4Aq]. **H_3AsO_4**, [**W**].

Asarone. $C_{12}H_{16}O_3$. [59°], (296°). S.G. 1·165. [**A**], [**E**], [**AA**], [*W* hot].

Asparagine. $C_4H_8N_2O_3$. S.G. $\underline{14}$ 1·52. [W.c. 1·8, 10°; 53, 100°]. (A), (E).

Aspartic Acid. $C_4H_7NO_4$. S.G. —— 1·66. [W ·45, 20°]. (A).

Aspidiospermine. $C_{22}H_{30}N_2O_2$. [206°]. [A 2, 14°], [E ·74, 14°], [**B**], [**C**].

Atropine. $C_{17}H_{23}NO_3$. Daturine. [114°]. W. ·33. [E], [**A**], [**C**].

Azobenzene. Syn. Azobenzide or Syn. Benzene-azo-benzene. PhN_2Ph. [68°], (293°). [A 8·5, 16°]. (W), [**E**], [B].

Barium Salts. **$BaBr_2$**, [c. 812°], S.G. 4·23, [W 20°, 104] [strong A]. **$BaCl_2$**, [c. 860°], S.G. 3·75–3·89, [W 32·2, 5°; 58·8, 100°], [A 99%, 14° ·01]. **BaF_2**, [c. 908°], S.G. $\underline{13}$ 4·58, [*W*], [HClAq], [NNO_3Aq], [HFAq]. **BaO_2H_2**, S.G. 4·495, [W 10°, 2·22; 80, 90·77]. **BaI_2**, S.G. 4·92, [W], [A]. **BaO**, S.G. 4·85, [W]. **BaO_2**, S.G. 4·96, (W combines).

Bebeerine. $C_{19}H_{21}NO_3$. [180°]. [*W*], [**A**], [**E**].

Benzene. C_6H_6. [6°], (80·1°). S.G. $\frac{14\cdot2}{4}$ ·8839. H.F.p. – 12,510. H.F.v. – 13,670. [*W*], [**A**], [**E**], [**acetone**], [**C**], [**AA**].

Benzidine. *Syn.* Diamido-diphenyl. *p-p-* [1 : 4] $NH_2.C_6H_4.C_6H_4.NH_2$ [1 : 4]. [122°], (above 360°), (W hot), [*W*], [**A**], [**E**]. (*Iso-*). *o-p-* [1 : 2], [1 : 4]-, [45°], (363°), [*W*].

Benzil. Ph.CO.CO.Ph. [95°], (346°–348° cor.). (W), [A hot], [E hot].

Benzo-*tri*-chloride. $C_6H_5CCl_3$. (214°). S.G. $\underline{14}$ 1·38. (W), Reacts with W or A, especially when hot.

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Benzoic Acid. $C_6H_5.CO_2H$. [121·4°], (249·2° cor.). S.G. $^{\underline{21}}$ 1·20; 1·337; 1·292. [W 207, 10°], [E 66, 15°], [A 47, 15°].

Benzoic Aldehyde and Compounds. $C_6H_5.CO.H$. (179°). S.G. $\frac{15}{4}$ 1·0504. [W ·33]. [A], [E]. **Ammonia-derivatives.** *Hydrobenzamide*, $(C_6H_5.CH)_3N_2$, [110°], (W), [A], [E]; *Amarine*, $C_{21}H_{18}N_2$, [100°], (W), [**A**], [**E**]; *Lophine*, $C_{21}H_{16}N_2$, [275°], (W), [*A*], [*E*].—**Benzoic Anhydride,** $(C_6H_5.CO)_2O$, [42°], (360° i. V.), S.G. $^{\underline{27}}$ 1·227, (W), [A], [E].

Benzoin. Ph.CH(OH).CO.Ph. [137°]. [*W* boil.], [*A*], [**A** hot], [E boil.].

Benzonaphthone. *V.* Naphthoquinone.

Benzonitrile. $C_6H_5.CN$. [– 17°], (190·5°). S.G. $^{\underline{17}}$ 1·008. [W 1, 100°], [A], [E].

Benzophenone. Ph.CO.Ph. [48°], (305° i. V.). (W), [**A**], [**E**].

Benzoyl-acetic Acid. $Ph.CO.CH_2.CO_2H$. [104°]. [***W*** hot], [**A**], [**E**], [**B** hot].

Benzoyl-acetone. $Ph.CO.CH_2.CO.Me$. [61°], (261°). [W hot], [A], [E].

Benzoyl Chloride. Ph.CO.Cl. [– 1°], (198°), (194°). S.G. $^{\underline{10}}$ 1·21. [E], [CS_2]. Decomp. by W, A.

Benzyl Alcohol. $Ph.CH_2.OH$. (206·5°). S.G. $\frac{20}{4}$ 1·0429. [*W*], [A], [E].

Benzylamines. $Ph.CH_2.NH_2$. (184°). S.G. $^{\underline{14}}$ ·99. [W], [A], [E]. **Di-**, $NH(CH_2.Ph)_2$, S.G. $^{\underline{14}}$ 1·033, (W), [**A**], [**E**]. **Tri-**, $N(CH_2.Ph)_3$, [91°], [A], [*W*].

Benzyl Chloride. $PH.CH_2.Cl$. (178° at 754 mm.) S.G. $\frac{17.8}{4}$ ·9453. [A], [E].

Berberine. $C_{20}H_{17}NO_4 4\frac{1}{2}aq$. [W 22, 21°], [A 1, 15°], (E).

Beryllium Compounds. **$BeBr_2$**, [c. 600°], [W]. **$BeCl_2$**, [c. 600°], [W], [A] **BeO**, S.G. 3·016, (W), [Acids].

Betaïne. Me_3NOCH_2CO. [W 16, 25°], [A], (E).

Bismuth Compounds. **$BiBr_3$**, [210°–215°], (454°-498°), decomp. by W, [E dry]. **$BiCl_3$**, [227°], (427°–439°). decomp. by W, [A dry]. **BiF_3**, not decomp. Aq, (A). **BiI_3**, S.G. 5·65, decomp. by W, [A c. 3·5, 20°]. **Bi_2O_3**, S.G. 8·08, [Acids]. **Bi_2O_4**, S.G. 5·6, [conc. HNO_3], [HClAq]. Bismuth salts mostly decomp. by W.

Biuret. $NH_2.CO.NH.CO.NH_2$. [190°]. [W 1·54, 15°], [A].

Boric Acid. *Ortho-*, H_3BO_3. S.G. $\frac{15}{}$ 1·434. [W 3·9, 19°], [A].

Borneol. $C_{10}H_{17}OH$. [198°], (207°). [*W*], [A], [E].

Bromal. Syn. Tri-bromo-acetic aldehyde, $CBr_3.CHO$, (174°), S.G. 3·34, [W.] **Bromal Hydrate,** $CBr_3.CH(OH)_2$, [54°], [W], [A], [E].

Bromhydric Acid. HBr. [– 73°], (– 69°). H.F. [H,Br] 8440; [H.Br.Aq] 28,376. [**W**]. *V.* Tab., p. 183. *Bromic acid* known only in [W].

Bromine. Br. [–7·05°], (58·7°). S.G. $\frac{0}{4}$ 3·1872. [W 3·327, 10°], [A], [E], [CS_2], [C].

Bromo-acetic Acids. $CH_2Br.CO_2H$, [51°], (208°), [**W**]. **Di-,** $CHBr_2.CO_2H$, [45°-50°], (233°), [**A**], [**E**]. **Tri-,** $CBr_3.CO_2H$, [130°], [135°], (250°), [**W**].

Bromo-benzene. C_6H_5Br. (Phenyl bromide.). (156°). S.G. $\frac{20}{4}$ 1·4914. (W), [A], [E].

Bromoform. $CHBr_3$. [8°], (151°). S.G. $\frac{15}{15}$ 2·9045. [*W*], [A], [E]. [Ess. oils].

Bromo-naphthalene. $C_{10}H_7Br[1]$. (5°), (280° cor.). S.G. $\frac{12}{}$ 1·5. (W), [A], [E], [B].

Brucine. $C_{23}H_{26}N_2O_4 4aq$. [178° anhyd.], [105° hydrat.], [151°]. [W ·12, 15°], [**A**], [**C**], [**Ess. oils**], (E), (Fatty oils).

Butyl Alcohols. *n*-, $CH_3(CH_2)_3OH$, (117°), S.G. $\frac{0}{0}$ ·8233, [W 8·3], [A]; *Iso-*, $(CH_3)_2CH.CH_2OH$, (106·7° at 763·2 mm.), S.G. $\frac{15}{15}$ .8069, [W 9·5, 18°], [A]; *Sec-*, $CH_3.CH_2.CMeH.OH$, (99° at 740 mm.), S.G. $\frac{0}{}$ ·827, [W], [A]; *tertiary*, $Me_3C.OH$, [25°], (83° cor.), S.G. $\frac{15}{15}$ ·7836.

Butylamines. *n*-, Pr.CH$_2$.NH$_2$, (76°), S.G. $\frac{0}{}$ ·755 [w]; *Primary iso*-, Ꝑr.CH$_2$.NH$_2$, (68°), S.G. $\frac{15}{}$ ·736; *Sec*-, CH$_3$.CH$_2$.CH(NH$_2$)Me, (63°); *Tertiary*-, Me$_3$CNH$_2$, (46° cor.), S.G. $\frac{15}{}$ ·7004, [w]; *Di-n.*, (Pr.CH$_2$)$_2$NH, (160°); *Di-iso*-, (Ꝑr.CH$_2$)$_2$NH, (137°).

Butyl Compounds. **C$_4$H$_9$Br**, *n*-, (100° cor.), S.G. $\frac{0}{}$ 1·305; *Iso*-, (92°), (91° at 758 mm.), S.G. $\frac{15}{15}$ 1·2722. **C$_4$H$_9$Cl**, *n*-, (78° cor.), S.G. $\frac{14}{}$ ·897; *Iso*-, (69°), S.G. $\frac{15}{15}$·883. **C$_4$H$_9$I**, *n*-, (131° cor.), S.G. $\frac{0}{0}$ 1·6476; *Iso*-, (120°), S.G. $\frac{15}{15}$ 1·6139. **Me$_2$CH.CH$_2$O.NO**, (*Iso*-, Bu-nitrite), (67°), S.G. $\frac{0}{}$ ·894.

Butylenes. *n*-, CH$_3$.CH$_2$.CH : CH$_2$, (c. – 4°); *ψ*-, Me.CH : CH.Me, (1°); *Iso*-, (Me)$_2$C : CH$_2$, (– 6°), S.G. $\frac{-14}{4}$ ·637. Gas is [*Aq*], [**A**], [**E**], [**AA**].

Butyric Acids. *n*-, Me.CH$_2$.CH$_2$.CO$_2$H, [c. – 3°], (162° cor.), S.G. $\frac{15}{15}$ ·967, [w], [A]; *Iso*-, (Me)$_2$.CH.CO$_2$H, (153° cor.), S.G. $\frac{15}{15}$ ·9539.

Butyric Aldehydes. *n*-, CH$_3$.CH$_2$.CH$_2$.CHO, (74°), S.G. $\frac{20}{4}$ ·8170, [W 3·7]; *Iso*-, (Me)$_2$CH.CHO, (64°), S.G. $\frac{15}{15}$ ·7972 [W 11, 20°].

Cadmium Compounds. **CdBr$_2$**, [570°], (806°–812°), S.G. $\frac{20}{4}$ 4·794, [W], [A], [E]. **CdCl$_2$**, [541°], (861°–954°), S.G. $\frac{17}{4}$ 3·655, [W 140, 20°; 150, 100°] [**A**]. **CdI$_2$**, [404°], (708°–719°), S.G. 5·6, also 4·6, [W 92·6, 20°; 133·3, 100°] [A] [E].

Caffeic Acid. C$_6$H$_3$(OH)$_2$.CH : CH.CO$_2$H. [**A**], [E].

Caffeine. Syn. Theine. C$_8$H$_{10}$N$_4$O$_2$. [230·5°]. S.G. $\frac{19}{}$ 1·23. [W 1·35, 16°; 45·6, 65°]. [A ·61, 16°; 3·12, 78°], [E ·044, 16°], [CS$_2$ ·06, 16°], [C 13, 16°].

Calcium Compounds. **CaBr$_2$**, [676°–680°], [W 141, 20°; 312, 105°], [A]. **CaCl$_2$**, [719°–723°], S.G. $\frac{6}{}$ 2·205, [W 60, 10°; 154, 99°], [**A**]. **CaF$_2$**, [c. 902°], S.G. $\frac{15}{4}$ 3·15–3·18], (W ·0004, 15°). **CaO$_2$H$_2$**, S.G. $\frac{0}{0}$ crys. 2·236, [W ·13, 15°; ·07, 100°], H.F., [Ca,O,H$_2$O] 146, 470. **CaI$_2$**, [631°], [W 204, 20°; 435, 92°], [**A**]. **CaS$_2$H$_2$.6aq**, [**W**], [**A**].

Camphor. $C_{10}H_{16}O$, [175°], (204°), S.G. $\underline{10}$ ·992, [W ·1], [A ·806, 120°], [E], [C]. **$C_{10}H_{15}BrO$,** [76°], (274°), S.G. 1·44, [A], [**C**], [**B**], [E], [**AA**], [milk], (alkalies).

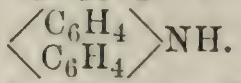
Camphoric Acid. $C_{10}H_{16}O_4$. [186°]. S.G. 1·19. [W ·625, 12°], [**A**], [**E**], $[a]_D = 46°$.

Cantharidin. $C_{10}H_{12}O_4$. [218°]. [W ·02, 15°; ·29, 100°], [A ·13, 15°], [B ·51, 15°], [E ·11, 18°], [CS_2 ·06, 18°], [C 1·2, 18°].

Caoutchouc. $C_5H_8+C_{10}H_{16}+$&c. S.G. c. 925. (W), (A), but swells in these. Eth., CS_2, $CHCl_3$, mineral oil, &c., &c., partially dissolve it (one constituent?).

Caproic Acid. *V.* Hexoic Acid.

Capsaicin. $C_9H_{14}O_2$. [59°]. (W), [A], [E].

Carbazole.  $\left\langle\begin{matrix}C_6H_4\\C_6H_4\end{matrix}\right\rangle NH$. [238°], (352° cor.). [A ·92, 14°; 3·88, 78°], [*Toluene*].

Carbazotic Acid. *Syn.* Tri-nitro-phenol, or Picric Acid. *q. v.*

Carbonates. **K_2CO_3,** [red heat], [W 111, 12°; 204, 70°] (A). **$KHCO_3$,** [W 22·4, 0°; 33·2, 20; 45·2, 40°], [A], *V.* Tab., p. 187. **Na_2CO_3,** [c. 818°], [W 46·2, 34°–75°]. *V.* Tab., p. 189 (A). **$(NH_4)_2CO_3.aq$,** [W], (A). **$NH_4.HCO_3$,** [W 11·9, 0°; 15·85, 10°; 21, (A), 20°]. **$(NH_4)_2CO_3.2NH_4HCO_3$,** (*sesqui-*), [W 25, 13°; 30, 17°]. **$BaCO_3$,** (W). **$CaCO_3$,** [W ·0094 (cold): 1·13, 100°]. **$MgCO_3$,** [*W*]. **$SrCO_3$,** [*W*]. These four are more sol. in W contg. CO_2. **Li_2CO_3,** [W 1·5, 0°; 1·18, 50°; ·728, 100°] (A). Carbs. of M′ all [W], all others practically (W) or nearly so.

Carbon Compounds. **C_2Br_4,** [53°]. **C_2Br_6,** (A), (E), [CS_2]. **CBr_4,** [91°], (189·5 at 760 mm.), S.G. 3·42, (W), [**A**], [**E**], [**CS_2**]. **C_2Cl_4,** (122°), S.G. $\underline{10}$ 1·62, (W), [A], [E], [Oils] (fixed and vol.). **C_2Cl_6,** [187°], (187°), S.G. 2·0, (W), [A], [E]. **CCl_4,** (76·74°), S.G. $\frac{0}{4}$ 1·63, (W), [A], [E]. **CO,** S.G. (air = 1) ·9678, (c. − 186°), H.F.p. 29,000, H.F.v. 29,290, [W ·0287, 6°; ·02315, 18·5°], [A ·20416, 13°]. **CO_2,** [− 65°], [− 57°],

[– 78·2°], H.F.p. [C,O_2] 96, 960, H.F.v.96,960, S.G. (liq.) – 34° 1·057, S.G. (sol.) c. 1·2. gas is [W 1·7967, 0°; 1·1847, 10°; ·9014, 20]; gas is [A 3·4875, 10·4°; 3·0391, 18°]. **$COCl_2$,** (8·2°) at 756 mm., S.G. $\frac{0}{4}$ (liq.) 1·432, gas is [AA], [B], decomp. W. **COS,** [W], [A]. **CS,** S.G. 1·66, (W), (A), [*E*], [*CS_2*]. **CS_2,** [c. – 12°] (46·04 at 760 mm.), S.G. $\frac{0}{4}$ 1·292, H.F.p. – 26,010, H.F.v. – 25,430, [*W*], [A], [E], [Oils (fix. and vol.)]. **$CSCl_2$,** (70°). **$CSCl_4$,** (146°–147°), S.G. $\frac{12\cdot8}{}$ 1·712.

Cardol. $C_{21}H_{30}O_2$ (?). [A], [E].

Carminic Acid. $C_{17}H_{18}O_{10}$. [W], [A], [*E*].

Carotin. $C_{26}H_{38}$ (?). (W), [*A*], [B], [CS_2].

Carvacrol. $C_6H_3MePr(OH)$ [1 : 4 : 2]. [c. 0°], (237° i. V.). S.G. $\frac{15}{15}$ ·986. [A].

Carvol. $C_{10}H_{14}O$. (228°). S.G. $\frac{11}{}$ ·9667. [A].

Catechin. [*W* cold], [**W** hot], [**EtOAc**]. From Bombay catechu.

Cellulose. $n\,[C_6H_{10}O_5]$. (All simple solvents), ["*Cuprammonia*"]. [$ZnCl_2Aq$] [Alkalies].

Cerium Compounds. **Ce_2Cl_6,** S.G. $\frac{15\cdot5}{15\cdot5}$ 3·88, [W]. **Ce_2I_6,** [W], [A].

Cetene. $CH_3.(CH_2)_{13}\,CH:CH_2$. [4°], (275°). S.G. $\frac{15}{4}$ ·7842. [A], [E].

Cetraric Acid. $C_{18}H_{16}O_8$. [*W*], [*E*], [**A** boil.].

Cetyl Alcohol. $C_{16}H_{34}O$ (*Ethal*). [50°], (344°). S.G. $\frac{50}{4}$ ·8176. (W), [A], [E], [Ess. Oils].

Chloral. $CCl_3.CHO$. [c. – 75°], (98° cor.), S.G. $\frac{0}{0}$ 1·5292, [Much W], [A], [E]; *C. hydrate.* $CCl_3.CH(OH)_2$, [57°], (97°), S.G. (sol.) 1·90, [**W**], [**A**], [**E**], [CS_2 2, 15°]; *C. alcoholate,* [56°], [46°], (115°); *C. ammonia,* $CCl_3.CH(OH).NH_2$, [64°], (W cold).

Chloralide. $C_5H_2Cl_6O_6$. [115°] (273°). (W.), [*A* cold], [E], [C].

Chlorhydric Acid. HCl. [−115·7° solidifies], [−112·5°]. H.F. [H,Cl], 22,000; H.F. [H,Cl,Aq], 39,315. [W 503, 0°, 760 mm.; 470, 10°]. [A S.G. ·836, 327]. *V.* Tab., p. 191.

Chlorine. Cl. [Solidifies c. − 102], (− 33·6° at 760 mm.) 1 vol. W at 10°, 760 mm. (maximum solubil.), absorbs 2·5852 vols of Cl.

Chlorates. $\mathbf{NH_4.ClO_3}$, [W], [A]. $\mathbf{KClO_3}$, S.G. 2·35, [W 6, 15°; 60, 104·8°], [A]. $\mathbf{NaClO_3}$, [W 82, 0°; 204, 100°], [*A*].

Chloro-acetic Acids. $CH_2Cl.CO_2H$, [63°], (186°), S.G. $\frac{73}{19}$ 1·366, [**W**]; *Di-*, $CHCl_2.CO_2H$, (190°), S.G. $\underline{15}$ 1·522, [W]; *Tri-*, $CCl_3.CO_2H$, [55°], (195°), S.G. $\frac{46}{15}$ 1·617, [**W**].

Chloro-acetic Aldehydes. $CH_2Cl.COH$, (85°), [W], [A], [E]; *Di-*, $CHCl_2.CHO$. (89°); *Tri-*, *V.* Chloral.

Chloro-acetones. $CH_3.CO.CH_2Cl$, (118°), S.G. $\underline{13}$ 1·158, [*W*]; *u-Di-*, $CHCl_2.CO.CH_3$, (120°), S.G. $\underline{15}$ 1·234, [*W*]; *s-Di-*, [44°], (173° cor.), [W], [**A**], [**E**]; *Tri-*, $CCl_3.CO.CH_3$, (180°); *u-Tetra-*, $CH_2Cl.CO.CCl_3$, (181°), S.G. $\underline{17}$ 1·482, [W]; *s-Tetra-* (180°), S.G. $\underline{17}$ 1·48, [W], [A]; *Penta-*, $CCl_3.CO.CHCl_2$, (192°), S.G. $\frac{14}{4}$ 1·576, W. 15; *Hexa-*, $CCl_3.CO.CCl_3$, [− 2°], (203°), S.G. $\underline{12}$ 1·744, [*W*].

Chloro-benzenes. C_6H_5Cl, [−40°], (132°), S.G. $\frac{20}{4}$ 1·1066, (W), [A], [E]; *o-Di-*, $C_6H_4Cl_2$, [1:2], (179° i. *V.*), S.G. $\underline{0}$ 1·328; *m-Di-*, [1:3], (172°), S.G. $\underline{0}$ 1·307; *p-Di-*, [1:4], [55°], (173°), S.G. $\underline{2·5}$ 1·458, [A]; *u-Tri-*, $C_6H_3Cl_3$, [1:3:4], [16°], (213° i. V.), S.G. (liq.) $\underline{12}$ 1·465; *c-Tri-*, [1:2:3], [54°], (219°); *s-Tri-*, [1:3:5], [63·5°], (208·5 i. V.); *c-Tetra-*, $C_6H_2Cl_4$, [1:2:3:4], [46°], (254° i. V.), [*A*], [**E**], [**Light petrol.**], [$\mathbf{CS_2}$], [**AA** 90%]; *i-Tetra-*, [1:3:4:5], [51°], [35°], (246° i. V.), [*A* cold] [B], [$\mathbf{CS_2}$], [**Light petrol.**]; *s-Tetra-*, [1:2:4:5], [138°], (245° i. V.), S.G. $\underline{10}$ 1·734, [B], [*A*], [*Light petrol.*]; *Penta-*, C_6HCl_5, [86°], (276°), S.G. $\underline{10}$ 1·842, [*A* cold], [**E**], [$\mathbf{CS_2}$]; *Hexa-*, C_6Cl_6, [226°], (326°), S.G. $\underline{23·3}$ 1·569, [*A* boil.], [*E*] [B].

Chloro-benzoic Acids. *o*-, $C_6H_4Cl\ (CO_2H)$, [1 : 2], [137°], [W ·114, 0°], [**W** hot], [**A**], [**E**]; *m*-, [1 : 3], [153°], [W ·035, 0°]; *p*-, [1 : 4], [236°], [*W*], [**A**], [**E**]; *Di*-, $C_6H_3Cl_2CO_2H$, [2 : 5 : 1], [156°], (301°), [W ·0850, 14°]; *Di*-, [3 : 2 : 1], [156°], (166°); *Di*-, [4 : 2 : 1], [158°]; *Di*-, [3 : 5 : 1], [182°]; *Di*-, [4 : 3 : 1], [201°]; *Tri*-, $C_6H_2Cl_3\ (CO_2H)$, [6 : 3 : 2 : 1], [c. 80°]; *Tri*-, [4 : 3 : 2 : 1], [129°], [W]; *Tri*-, [5 : 4 : 2 : 1], [163°], [*W* cold]; *Tetra*-, [5 : 4 : 3 : 2 : 1], [186°], [*W*], [**A**], [**E**].

Chloroform. $CHCl_3$. [– 70°], (60·9° at 754·3 mm.) S.G. $\frac{15}{15}$ 1·50 [W ·987, 0°; ·775, 55°]. H.F.v. 23,530. [A], [E].

Chloro-naphthalic Acid. $C_{10}H_4Cl(OH)O_2$. (Chloro-oxy-(α)-naphthaquinone [above 200°], (W), [A], [E].

Chloro-phenols. $C_6H_4Cl(OH)$. *o*., [2 : 1], [7°], (176° i. V), [*W*], [**A**], [**E**]; *m*., [3 : 1], [28·5°], (214° i. V.); *p*-, [4 : 1], [37°], (217°), [**A**], [**E**], [*W*]; *Di*-, $C_6H_3Cl_2(OH)$, [4 : 2 : 1], [42°], (210°), [*W*], [A], [E]; *Di*-, [6 : 2 : 1], [63°], (218°), [*W*], [A], [E]; *Tri*-, $C_6H_2Cl_3(OH)$, [6 : 4 : 2 : 1], [68°], (244°), [*W*].

Chlorophyll. (W), [A], [E], [CS_2], [Ethereal oils].

Chloropicrin. $CCl_3(NO_2)$. (*Tri-chloro-nitro-methane*). (112° cor.). S.G. $\frac{0}{4}$ 1·69. [A, 80·5, ·743]. [*W*], [**A**], [**E**].

Chloro-propionic Acids. α-, $Me.CHCl.CO_2H$, (186°), S.G. $\frac{0}{}$ 1·28, [w]; β-, $CH_2Cl.CH_2CO_2H$, [41°], [38°], (204°), [**W**], [**A**]; *αα-Di*-, $CH_3.CCl_2.CO_2H$, (c. 188°), [**W**], (**Conc. HCl**); *αβ-Di*-, $CH_2Cl.CHCl.CO_2H$, [50°], (210°); *ββ-Di*-, $CHCl_2.CH_2.CO_2H$, [56°].

Chloro-quinones. $C_6H_3ClO_2$, [57°], [**E**], [A], [AA], [W hot]; (α)-*Di*-, $C_6H_2Cl_2O_2$, [5 : 2 : 4 : 1], [159°], [E], [C], [*A*], (W); (β) *Di*-, [2 : 6 : 1 : 4], [120°], [**A** boil.], [*W* hot]; *Tri*-, $C_6HCl_3O_2$, [163°], [**E**], [A hot], (W); *Tetra*-, $C_6Cl_4O_2$, [E], [*A* cold], (W); *Tetra-o*-, [1 : 2 : 3 : 4 : 5 : 6], [132°], [**AA**].

Chloro-resorcins. $C_6H_3Cl(OH)_2$, [89°], (256°), [W], [A], [E], [B], [CS_2]; *Di-*, $C_6H_2Cl_2(OH)_2$. [77°], (249°). [**W**], [**A**], [**E**], [**B**], [$\mathbf{CS_2}$]; *Tri-*, $C_6HCl_3(OH)_2$, [83°] [73°], (W), [**W hot**], [**A**], [**E**]; *Penta-*, $C_6HCl_5O_2$, [92·5°], [$\mathbf{CS_2}$], [**B**], [**A**], [E].

Chloro-sulphonic Acid. $Cl(SO_2.OH)$. S.G. $\frac{0}{4}$ 1·784, (155·3°, 760 mm.). Decompd. by most solvents.

Cholesterin. [146°]. S.G. $\frac{0}{20}$ 1·046. (W), [**A** hot], [*A.* cold], [**E**], [**C**], [$\mathbf{CS_2}$], [**oil turp.**]. *Para-*, [A], [**A** hot], [**E**], [**C**]. *Iso-* [138–138·5], [**A** hot], [E], [Acetone].

Cholic Acid. $C_{24}H_{40}O_5$. [195°]. [W 133, 100°; ·025, 15°].

Chromates. $\mathbf{Am_2CrO_4}$, [**W**] (A). $\mathbf{BaCrO_4}$, S.G. 3·9, (W) [HClAq], [HNO_3Aq]. $\mathbf{K_2CrO_4}$, S.G. ^{4} 2·71, [W 58·9, 0°; 62·94, 20°; 79·1, 100°], (A). $\mathbf{K_2Cr_2O_7}$, [c. 400°], S.G. ^{4} 2·692, [W 4·9, 0°; 8·4, 10°; 73, 80°; 102, 100°; 262·7, 180°]. (A). $\mathbf{Na_2CrO_4}$. **10 aq**, [**W**] (A). Nearly all other salts (W).

Chromium Compounds. $\mathbf{CCl_2}$, [W]. $\mathbf{CrCl_3}$, (W), (Acids). Another form, $\mathbf{CrCl_3xaq}$, [W]. $\mathbf{Cr_2O_3}$, S.G. 4·9–5·1, [Acids]. $\mathbf{CrO_3}$, [c. 190°], S.G. 2·67–2·82, [W 165, 26°], [E] $\mathbf{CrO_2Cl_2}$, (115·9°), S.G. $\frac{0}{4}$ 1·9617, [W with decomp.]. $\mathbf{H_2CrO_4}$, [**W**].

Chrysamic Acid. *V.* Tetra-nitro-oxy-amido-anthraquinone.

Chrysaniline. $C_{19}H_{15}N_3$. [267°–270°]. [A], [B].

Chrysene. $C_{18}H_{12}$. [250°], (above 360°). [A ·097, 16°; ·17, 78°]. [Toluene 5·39, 100°]. [*A*], [*E*], [CS_2], [B boil.], [AA].

Chrysophanic Acid. *V.* Di-oxy Methyl Anthraquinone.

Cinchonidine. $C_{19}H_{22}N_2O$, [210° cor.], [W], [A 97%, 6·1, 13], [E ·53, 15°]; B′HClaq, [W, 3·3, 10°], [E ·3, 10°]; $B'_2H_2SO_4$,6aq. [W 1, 12°]; – 2 aq, [W]; $B'C_7H_6O_2$, (Benzoate), [W ·3, 10°]. $B'C_7H_6O_3$, (Salicylate), [W ·13, 18°]. **Cinchonine.** $C_{19}H_{22}N_2O$, [236°], [W ·262, 10°], [A S.G. ·852, ·71, 16°], [E ·27, 10°], [C 28]; B′HCl2aq, [W 4·2, 10°], [A 77, 16°], [E ·35]; $B'_2H_2SO_4$2aq, [W 1·5, 13°]; $B'_2C_4H_6O_6$2aq, (Tartrate), [W 3, 16°]; $B'_3C_6H_8O_7$4aq, [W 2·1, 12°].

Cinchonamine. $C_{19}H_{24}N_2O$, [194°], [185°], [*W*], [A], [E], [C], [CS_2], [B]. B·HNO_3 [W ·2, 15°]. B′H_2SO_4, [**W**].

Cinnamic Acid. Ph.$(CH)_2$.CO_2H. [133°], (300°). [W ·03, 17°], [A 2·3, 20°], [C 6, 15°], [CS_2 ·9, 15°], [**E**].

Cinnamic Aldehyde. Ph.$(CH_2)_2$CHO. (129°). S.G. $\frac{20}{4}$ 1·049. [E], [A boil.], [*W* boil.].

Cinnamol. Syn. styrene.

Citraconic Acid. $C_5H_6O_4$. [80°]. S.G. 1·6. [**W**], [**A**], [**E**].

Citric Acid. $C_6H_8O_7$. [147°]. S.G. 1·54. [W 125, 15°; 200, 100°]. –aq. is [A 80%, 87, 15°], [A absol., 75·9, 15°], [E].

Cobalt Compounds. **$CoBr_2$**, [**W**] [A]. **$CoCl_2$**, [**W**], [**A**]. **CoS_2**, [W], [A]. Oxides and hydroxides are [acids].

Cocaine. $C_{17}H_{21}NO_4$. [98°], [W ·14, 12°]. [**A** hot], [**E**]. B′HCl. [A].

Codeine. $C_{18}H_{21}NO_3$. [150°]. S.G. 1·32. [W 1·26, 15°; 5·85, 100°], [Amyl Alcoh. 15·68], [B 9·60], [A [$[\alpha]_D$ – 134°]], [E], [CS_2]. B′HCl2aq, [W 5, 15·5]. $B'_2H_2SO_4$5aq, [W 3·3, cold].

Colchicine. $C_{22}H_{25}NO_6$. [145°]. [W], [A], (E).

Colocynthin. [W 5 cold; 6·3 hot]. [A], (E), (CS_2), (B), (C).

Columbin. $C_{21}H_{22}O_7$. [182°]. [*W*], [*E*], [A 3, 78°].

Comenic Acid. $C_6H_4O_5$. [W above 6, 100°], (A).

Coniferin. $C_{16}H_{22}O_8$. [185°]. [W ·51, cold], [**W** hot], [*A*], (E), $[a]_D = -$ 66·9 at 20°.

Coniine. $C_5H_{10}PrN$. (169°). S.G. $^{12\cdot5}$ ·846, (·886), [W 1·11, cold], [E 17], [**A**], [**C**], [B], [**Amyl alcoh.**]. [**Acetone**], [CS_2], $[a]_D = 13\cdot8$. B′HBr, [100°], [W].

Convallamarin. $C_{23}H_{44}O_{12}$. [**W**], [**A**], [*E*].

Convolvulin. $C_{31}H_{50}O_{16}$. [150°]. (W), (E), (CS_2), (B), [C], [HClAq], [H_2SO_4].

Copper Compounds. **$CuBr_2$**, [**W**] (B). **Cu_2Br_2**, [504°], S.G. 4·72, (W). **$CuCl_2$**, [**W**], [A], [E]. **Cu_2Cl_2**, (W), (A), (HNO_3 dil.), (H_2SO_4Aq), [HClAq], [NH_3Aq], [KClAq], [NaClAq]. **Cu_2I_2**, S.G. 4·41, (W), (A), (Acids dil.), [HIAq], [I. in alcoh. sol.]. **Cu_2O**, S.G. $\underline{4}$ 5·7, (W), (A), [NH_3Aq]. **CuO**, S.G. 6·1–6·4, (W), (A), [Acids].

Corydaline. $C_{18}H_{19}NO_4$. [130°]. (W), [**A**], [**E**].

Cotoïn. $C_{22}H_{18}O_6$. [130°]. [*W*], [**A**], [**C**], [**B**]. Paracotoïn, $C_{19}H_{12}O_6$, [152°], [E], [C].

Coumaric Acids. $C_9H_8O_3$; *o*-, [208°]. [*W*], [*E*], [**A**], (C), (CS_2); *m*-, [191°], [W hot], [A], [E], [B]; *p*-, [206°], [*W*], [**W** hot], [**A**], [**E**], [*B*].

Coumarin. $C_9H_6O_2$. [67°], (290°). [W hot], [**A**], [E].

Creatine. $C_4H_9N_3O_2$. S.G. 1·35. [W 1·3, 18°], [A ·016] (E).

Creatinine. $C_4H_7N_3O$. [W 9, 16°], [A 1, 16°; ·3, 16°], [**W** hot].

Creosol. $C_8H_{10}O_2$. (220°). S.G. $\underline{13}$ 1·0894, [*W*], [A], [E], [B].

Cresols. $C_6H_4Me(OH)$, *o*-, [2 : 1], [30°], (190·8), S.G. $\frac{0}{0}$ 1·0578; *m*-, [4°], (202·8°), S.G. $\frac{0}{0}$ 1·0498, [W], [A]; *p*-, [36°], (201·8), S.G. $\frac{0}{0}$ 1·0522, [W], [A].

Crotonic Acid. $Me(CH)_2CO_2H$, [72°], (185°), [W 8, 19°]. **Aldehyde**, $Me(CH)_2COH$, (105°), S.G. $\underline{0}$ 1·033, [W].

Cubebin. $C_{10}H_{10}O_3$. [125°]. [A 1·31, 12°], [E 3·75], [*W*].

Cuminic Acid. *o-Iso-*, $C_6H_4.Pr.CO_2H_2$, [1 : 2), [**A**], [**E**], (W); *p-Iso-*, [1 : 4], [117°], [*W*], [**A**], [**E**]; *ψ*-, $C_6H_2Me_3CO_2H$, [1 : 2 : 4 : 5] [149°], [*W* boil.], [**A**], [**E**].

Curarine. [**W**], [**A**], [C] [E].

Curcumin. $C_{14}H_{14}O_4$. [178°]. [*W*], [*B*], [*CS_2*] [AA], [A], [E].

Cyanates. **AmCNO,** [**W**]. **KCNO,** S.G. 2·05, [**W**], (A absol.), [A 82 %].

Cyanhydric Acid. **HCN.** [–15°]. S.G. (liq.) $\frac{18^\circ}{}$ ·6969. H.F. [C,N,H], –27,480; [$C_2N_2.H_2$] 10,740. [W], [A], [E].

Cyanic Acid. (C ⋮ N).OH. S.G. $\frac{0}{}$ 1·14. Decomp. W or A.

Cyanic (Sulpho Acids). **HCNS.** [W]; $\mathbf{H_2S_2C_2N_2}$, [*W*], [A].

Cyanides and Sulphocyanides. **AmCN,** [**W**], [**A**]. $\mathbf{Ba(CN)_2}$, [*W*]. $\mathbf{K_3Fe(CN)_6}$, S.G. 1·8, [W 36·6, 10°; 81·9, 104°], [*A*]. $\mathbf{K_4Fe(CN)_6}$. S.G. 1·86, [**W**], (A). **K(CN),** S.G. $\frac{16}{}$ 1·52, H.F. [K,C,N] 32,500, [**W**], [strong *A*]. **Na(CN),** [**W**], [*A*]. $\mathbf{NH_4S(CN)}$, S.G. $\frac{13}{}$ 1·30, [**W**], [**A**]. **KS(CN),** [162°], S.G. 1·9, [W 177·2, 0°; 217, 20°], [A].

Cyanine. *V.* Quinoline.

Cyanogen. CN. [– 34·4°]. S.G. $\frac{17}{}$ ·886. Gas is [W 4·5, 20°], [A 23, 20°], [E 5, 20°]. H.F. [C_2,N_2] – 65,700.

Cyanogen Compounds. **C ⋮ NBr,** [**W**], [**A**]. **C ⋮ NCl,** [W 25], [A 100], [E 50]. **C : NI,** [W], [A], [E], [vol. oils]. $\mathbf{(C:N)NH_2}$, (Cyanamide) [40°], [**W**], [**A**], [**E**], [*C*], [*CS_2*], [*B*]. $\mathbf{C_3H_3N_3O_3}$, (*n*-, Cyanuric acid), [W 2·5 cold], [W hot], [A, 21°–24°, ·1]. $\mathbf{C_6H_6N_6}$, (*n*-, Cyanuramide), (*n*-, *Melamine*), [*W*], [**W** hot], [*A* hot]. $\mathbf{(CN)_2S}$, [c. 60°, [W], [A], [E].

Cymene. C_6H_4MePr. (Cymol.) [1 : 4], (175°). S.G. $\frac{20}{4}$ ·8569. (W]), [A], [E], [oils fix. and vol.].

Cytisine. $C_{20}H_{27}N_3O$. [155° cor.]. [**W**], [**A**], [*E*], [*B*], [*C*].

Delphinine. $C_{22}H_{35}NO_6$. [119°]. [W ·02, 20°], [A 5, 20°], [E 9, 20°], [C 6·3, 20°].

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Dextrin. $(C_{12}H_{20}O_{10})_n$. [**W**], (A 60%), (E).

Digitalin. [A 90% 8·5, cold; 17, boil.], (W), [*E*], [**C**], [AA]. **Digitaleïn,** [W], [A], [*C*], (E).

Dulcite. $CH_2(OH)(CHOH)_4CH_2OH$. [189°]. S.G. $\frac{15}{}$ 1·466. [W 3, 15°], [A ·07, 15°], [*Acetone*], [*C*], (E).

Durene. $C_{10}H_{14}$. *s*-, $C_6H_2(Me)_4$ [1:2:4:5], [81°], (196° i. V.), [*AA* cold], [**A**], [**E**], [**B**]; *u*-, [1:3:4:5], (196° i. V.); *c*-, [1:2:3:4], [– 4°], (204° i. V.).

Ecgonine. $C_5NH_3Me.CH(OH).CH_2.CO_2H$. [*W*], (E), [A].

Elaterin. $C_{20}H_{28}O_5$. (W), [*E*], [**A**].

Ellagic Acid. $C_{14}H_6O_8$. S.G. $\frac{18}{}$ 1·667. [*A*], (W), (E).

Emetine. [65°-74°]. [*W*], [**C**], [**A**], [$\mathbf{CS_2}$], [*E*], [*B*].

Eosin. $C_{20}H_8Br_4O_5$. (Tetra-bromo-fluoresceïn.) [*W*]. [*B*], [A].

Ergosterin. $C_{26}H_{40}O$. [154°]. S.G. 1·04. $[a]_D$ – 114°, [A], [E], (W).

Ergotinine. $C_{35}H_{40}N_4O_6$. [A 95% ·5, 20°; 2, 78°], $[a]_j$, 137·5°.

Erythrite. $C_4H_{10}O_4$. [112°], (330°). S.G. 1·45. [**W**], [*A* cold], (E).

Ethal. *V.* Cetyl Alcohol.

Ethane. $CH_3.CH_3$. H.F.p. 25,670; 28,560; 28,000. H.F.v. 24,510; 27,400. [W ·0871, 0°], [A 1·5].

Ether. Et_2O. [– 117°], (34·6°). S.G. $\frac{15}{15}$ ·7201. [W 8·3, 17·5°]. H.F.p. 70,040. H.F.v. 67,430. [A], [CS_2], [C].

Ethylamines. **NH_2Et**. (19°), S.G. $\frac{8}{}$ ·6964, [W]. *Di*- **$NHEt_2$**, (56°), S.G. $\frac{10}{}$ ·716, [**W**]. *Tri*-, **NEt_3**, (90°), S.G. $\frac{20}{4}$ ·7277, [*W* cold]. **NEt_4OH**, [W].

Ethyl Compounds. **EtBr,** (38·4°), S.G. $\frac{15}{4}$ 1·4189, [A], [E], [*W*]. **Et_2CO_3,** (126° cor.), (W), **[A]**, [E]. **EtCl,** (12·5), S.G. $\frac{6}{6}$ ·9171, gas is [*W*], **[A]**, **[E]**. **EtI,** (72°), S.G. $\frac{15}{15}$ 1·9433, [*W*], [A], [E]. **$EtNO_3$,** (86°), S.G. $\underline{15\cdot5}$ 1·112, [A], [E]. **$EtNO_2$,** (18°), S.G. $\underline{15\cdot5}$ ·900 [*W*], [A]. **$EtHSO_4$,** S.G. $\underline{16}$ 1·316, [W], [A], (E). **Et_2SO_4,** [c. – 24°] (118° at 40 mm). **EtCN,** (97°), S.G. $\frac{4}{4}$ ·7998, [W], [A], [E]. **Et_2SO_3,** (161°), S.G. $\underline{16}$ 1·085, (W), [A], [E]. **EtS.CN,** (146° cor.), S.G. $\underline{16}$ 1·02, (W), [A], [E]. **EtN.CS,** (– Thiocarbimide), (133°), S.G. $\frac{4}{4}$ ·995.

Ethylene and Compounds. $CH_2:CH_2$, [– 169°], (– 103°), [W ·25, 0°], [A 3·6, 0°], [E]. *Diamine*, $NH_2.CH_2.CH_2.NH_2$, [8°], (117°), S.G. $\underline{15}$ ·902 **[W]**. *Bromide*, $C_2H_4Br_2$, [9·2°], (131·5° cor.], S.G. $\frac{15}{15}$ 2·189, [A], [E], (W). *Chloride*, $C_2H_4Cl_2$, (83·7°), S.G. $\frac{15}{15}$ 1·256, [A], [E]. *Iodide*, $C_2H_4I_2$, [82°], (W), **[E]**, [**A** boil.]. *Oxide*, C_2H_4O, (13·5°), S.G. $\underline{0}$ ·897, [W], [A].

Eucalyptol. $C_{10}H_{18}O$. [1°], (176° i. V.). S.G. $\underline{16}$ ·923.

Eugenol. $C_{10}H_{12}O_2$. (252°). S.G. $\underline{15}$ 1·066. [*W*], **[A]**, **[E]**, **[HOAc]**.

Euonymin. (W), [A], [E].

Fluoranthene. $C_{15}H_{10}$. [110°], (251°, 60 mm.). [*A* cold], [**A** hot], **[E]**, **[CS_2]**, **[HOAc]**.

Fluorene. $C_{13}H_{10}$. [113°], (295° i. V.). **[E]**, **[B]**, **[CS_2]**, [*A* cold], [**A** hot].

Fluoresceïn. $C_{20}H_{12}O_5$. [*W* hot]. When freshly ppd. **[A]**, **[E]**; when crys. [A or E boil.].

Fluorhydric Acid. HF. [– 92·3°], (19·44°). S.G. $\frac{12\cdot78}{12\cdot78}$ ·9879. **[W]**.

Formamide. HCO_2. (192°–195°). [W], [A], [E].

Formamidoxim. $NH_2.CH:NOH$. [105°]. **[W]**, [*A*].

Formic Acid and Formates. HCOOH, [2°], [8·6°], (101°), S.G. $\frac{15\cdot1}{4}$ 1·225, [W], [A with partial combinn.]. Formates are all [W]. **CaA′$_2$**, S.G. 2·02, [W 10 to 12·5, cold], (A). **KA′**, S.G. 1·908, [150°]. **NaA′**, (200°), S.G. 1·919, [W], [*A*], (E). **SrA′$_2$2aq**, S.G. 2·667, [W]. **MeA′**, S.G. $\frac{15}{15}$ ·982, [A]. **EtA′**, (53·5° at 754·5 mm.), (55°), (54·4°), S.G. $\frac{15}{15}$ ·9298, [W 11, 18], [A], [E]. **PrA′**, (81) at 760 mm., S.G. $\frac{15}{15}$ ·9099, [W 2·2, 22°]. **PrA′**, (68–71°), S.G. $\frac{0}{}$ ·8826. **BuA′**, (iso-), (97·9° at 760 mm.), S.G. $\frac{0}{4}$ ·8854, [W 1, 22°].

Formic Aldehyde. CHO_2, [W], [A].—**Paraldehyde.** (CH_2O_3), [152°], (W), (A), (E), [Alkalies].

Formose. $C_6H_{12}O_6$. [*A*], (E).

Frangulin. $C_{21}H_{20}O_9$? [230°]. (W), [*A* 80%], [*E*], [B].

Fraxin. $C_{16}H_{18}O_{10}\frac{1}{2}$aq. [*W*], [**W** hot], [*A* cold], [A hot], (E).

Fumaric Acid. $CO_2H.CH:CH.CO_2H$. [W ·67, 16·5], [A 70% ·48, cold].

Furfuraldehyde. $C_4H_3O.CHO$. (162°). S.G. $\frac{20}{4}$ 1·1594. [W 9, 13°], [**A**].

Furfurine. $C_{15}H_{12}O_3N_2$. [116°]. [W ·021, 8°; ·75, 100°] [**A**], [**E**].

Gallic Acid. $C_6H_2(OH)_3(CO_2H)$ [5 : 4 : 3 : 1]. [220°–240°]. [W 1, cold; 33, 100°], [A 28 15°], [E 2·5, 15°].

Gelatin. (W, cold), [W, hot], (A), (E), (C).

Gelsemine. $C_{22}H_{38}N_2O_4$. [Below 100°]. [*W*], [A], [**E**], [**C**].

Gentianin. $C_{14}H_{10}O_5$. [*W*], [E], [**A** boil.].

Gluten. (W), [conc. acids and alkalies], [HCl of 0·2%] (E), [part in A].

Glyceric Acid. $CH_2OH.CHOH.CO_2H$. [W], [A], (E).

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Glycerin. CH$_2$OH.CHOH.CH$_2$OH. [20°], (180° at 12·5 mm.). S.G. $\frac{15}{15}$ 1·2624. [W], [A], [C], (E). *V.* Tab., p. 198.

Glycocholic Acid. C$_{26}$H$_{43}$NO$_3$. [W ·33, cold, ·83, 100°], [E ·093, 20°], [B ·009], [c. ·011].

Glycocoll. C$_2$H$_5$NO$_2$. (232°–236° cor.]. [*W*], (A), (E).

Glycogen. C$_6$H$_{10}$O$_5$. [W], (A).

Glycol. CH$_2$OH.CH$_2$OH. [– 11·5°], (198° cor.). S.G. $\frac{15}{15}$ 1·1168. [W], [A], [*E*].

Glycollic Acid. HO.CH$_2$.CO$_2$H. [79°]. [W], [**A**], [**E**].

Glycyrrhizic Acid. C$_{44}$H$_{63}$NO$_{18}$. [*A*], [*E*].

Glyoxal. CHO.CHO. Containing x aq it is [**W** cold]; dry is [*W*], [**A**], [**E**].

Glyoxaline. C$_3$H$_4$N$_2$. [89°], (225°). [**W**], [**A**], [**E**].

Glyoxylic Acid. H.CO.CO$_2$H. [**W**].

Gold Compounds. **AuBr$_3$**, [W], [E]. **AuCl**, (W). **AuCl$_3$**, [W], [E]. **AuI$_3$** (W).

Guaiacol. C$_6$H$_4$(OH)(OMe). [28·5°], (205°). S.G. ^{15} 1·143. [A], [E], [*W*].

Guanine. C$_5$H$_5$N$_5$O. (W), (A), (E).

Hæmatoxylin. C$_{16}$H$_{14}$O$_6$. [*W*], [**A**] [**E**].

Helenin. C$_6$H$_8$O. [110°]. [*W*], [**A**].

Helicin. C$_{13}$H$_{16}$O$_7$. [170°], [174°], [175°]. [W 1·6, 8°], [**W** boil.], [A], (E).

Hemipic Acid. C$_{10}$H$_{10}$O$_6$. [180°]. [*W*], [A], [E].

Hesperidin. C$_{22}$H$_{26}$O$_{12}$. [251°]. [*W* hot], [A], [a]$_D$ – 89°.

Hexoic Acid. C$_6$H$_{12}$O$_2$. *n*-, Me(CH$_2$)$_4$CO$_2$H, [– 1·5°], (205°), S.G. $\frac{0}{0}$ ·9146, [*W*]. *Iso-*Pr.(CH$_2$)$_2$.CO$_2$H, (200° i. V.), S.G. ·925, [*W*], [A absol.].

Hippuric Acid. $NH(C_7H_5O).CH_2.CO_2H$. [187°]. S.G. 1·308. [W 1·7, 0°], [Iso-amyl-alcoh. 2, 9°], [**W** boil.], [**A** hot], [*E*].

Hydrastine. $C_{21}H_{21}NO_6$. [132°]. [*W*], [*A* cold], [**A** boil.], [C [a]$_D$ − 67·8°].

Hydrobenzoin. $Ph.(CH(OH))_2Ph$. [134°], (above 300°). [W ·25, 15°; 1·25, 100°], [**A**].

Hydrogen. H. [·0193, 0°–20°]. [A ·06925, 0°].

Hydrogen Peroxide. H_2O_2. [w], [A], [*E*].

Hydrogen Sulphide. H_2S. [c. − 85·5], [c. − 61·8, 760 mm.]. [W 3·23, 15°; 2·9, 20°; 1·86, 40°], [A 9·54, 15°; 5·62, 25°]. H.F., [H_2.S] 4740.

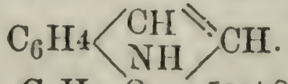
Hydroquinone. $C_6H_4(OH)_2$ [1 : 4]. [169°]. [W 6·21, 15°], [**W** hot], [**A**], [**E**], [*B*].

Hydurilic Acid. $C_8H_6N_4O_6$. [*W*], [W hot], [*A*].

Hyoscyamine. $C_{17}H_{23}NO_3$. [109°]. [W], [A], [C].

Hypoxanthine. $C_5H_4N_4O$. [W ·33, cold; 1·28, 100°], [A ·11, 78°].

Indigo, &c. $C_{16}H_{10}N_2O_2$. (W), (A), [*A* hot], (E), [*C*], [*AA*], [**nitro-benzene**], [**hot aniline**], [**phenol**], [conc. H_2SO_4]. *Leucindigo*, $C_{16}H_{12}N_2O_2$, [A], [E], (W). *Indican*, [W], [A]. *Indirubin*, $C_{16}H_{10}N_2O_2$, [A], [E], [B], [AA], (W).

Indole. 
$C_6H_4\left\langle\begin{matrix}CH\\NH\end{matrix}\right\rangle CH$. [52°], (254°). [W hot], [**A**], [**E**], [**Ligroin**].

Inosite. $C_6H_{12}O_6$. [217°], [225°], (319° in vac.). S.G. $\frac{15}{}$ 1·752. [W 10, 12°; this is with − 2Aq], [*A* dil.], (A), (E).

Inulin. $(C_6H_{10}O_5)_x$. [160°]. S.G. 1·36. [*W*], [**W** hot], (A).

Iodhydric Acid. HI. [−55° solidif.]. H.F. [H gas, I sol.] = − 6036°; both gas at 180° = − 436°; [H,I,Aq] = 13,170. [**W**]. V. Tab., p. . The aq. soln. contg. 57% boils 127° at 744 mm. almost unchanged.

Iodine Compounds. **I,** [*W*], [**CS_2**], [**C**], [**E**], [**A**], [B], [Turp. oil; explosv.], [Aldehyde], [Glycerin]. **IBr,** [36°], [A], [C], [E], [CS_2]. **IBr_5,** [W]. **ICl,** [24·2°], (101·3), [A], [E]. **ICl_3,** (W partl. decomp.], [B]. **I_2O_5,** [c. 300°], (E), (A), (C), (CS_2), (B), [W forming HIO_3]. **HIO_3,** [**W**]. *V.* Tab., p. 200.

Iodobenzenes. C_6H_5I, (188°). S.G. $^{0}_{0}$ 1·86, (W); *o-Di-*, [1:2], [27°], [287°], [*W*], [A] *m-Di-*, [1:3], [37°], (285°), [A + E].

Iodoform. CHI_3. [119°]. S.G. 2. (W), [**A**], [**E**].

Iron Compounds. **$FeBr_2$,** [W]. **$FeBr_3$,** [W], [A], [E]. **$FeCl_2$,** [W], [A], (E). **$FeCl_3$,** [W], [A], [E]. **FeO,** (W), [Acids]. **Fe_2O_3,** (W), [Acids]. **Fe_3O_4,** (W), [Acids]. **FeI_2,** [W], [A].

Isatin. $C_8H_5NO_2$. [201°]. [*W*], [W boil.], [**A**], [*E*].

Itaconic Acid. $C_5H_6O_4$. [161°]. S.G. 1·6. [W 5, 10°], [A 88%, 25, 15°], [E].

Jalapin. $C_{34}H_{56}O_{16}$. [150°]. [*W*], [**A**], [**E**], [**C**], [B], [HOAc].

Jervine. $C_{26}H_{37}NO_3$. [*W*], [A], [*E*].

Lacmoid. [A], [Amyl HO], [AcOH], [E], [W], (B).

Lactic Acid. $CH_3.CH(OH).CO_2H$. S.G. $^{15}_{4}$ 1·2485. [W], [A], [*E*].

Lactucin. [W 1·25], [A], [AcOH], [*E*].

Lanthanum Compds. **$LaCl_3$,** [W], [A]. **$LaBr_3$, 7aq,** [W], [A]. **La_2O_3,** [acids]

Lauric Acid. $C_{12}H_{24}O_2$. [43·6°]. S.G. ^{20} ·883. (W), [**A**], [**E**].

Lead Compounds. **$PbBr_2$,** [c. 449°], (c. 861°), [*W* hot]. **$PlCl_2$,** [498°], (861°–954°), [*W*]. [**W** hot] (A) (B). **PbI_2,** [c. 383°], (861°–954°), [W ·03, cold; ·515, boil.] (A). **PbO,** S.G. c. 9·25, [many Acids].

Lepiden. $C_{28}H_{20}O$. [175°], Vol. 220°. (W), [*A*], [*E*], [*AA*], [B].

Leucine. $C_6H_{13}NO_2$. [170°]. [W 2·2, 18°], [*A*], (E).

Linoleic Acid. $C_{18}H_{32}O_2$. S.G. $\underline{14}$ ·92. (W), [**E**], [A].

Lithium Compounds. **LiBr,** S.G. 3·1, [W 143, 0°; 270, 103°]. **LiCl,** S.G. 2·0, [W 63·7, 0°; 145, 160°] [A] [E]. **LiI,** S.G. 3·4, [W 151, 0°; 588, 120°]. **LiOH,** [W], (E + A).

Lobeline. [**W**], [**A**], [**E**].

Magnesium Compounds. **$MgBr_2$,** [**W**], [A]. **$MgCl_2$,** [**W**], [A], [AmHO], *V.* Tab., p. 202. **MgI_2,** [**W**] [A] [E]. **MgO,** [*W*], [Acids].

Maleic Acid. $CO_2H.CH:CH.CO_2H$. [130°]. [**W**], [**A**], [E].

Malic Acid and Salts. $CO_2H.CH_2.CH(OH).CO_2H$, [100°], $[a]_D = -3$ in dil. soln., [**W**], [**A**], [E]. **Am_2A_2,** [**W**]. **KHA″,** [W], (A). **NaHA″,** [W], (A). **BaA″aq,** [W]. **$BaH_2A''_2$,** [W]. **SrA″aq,** [W]. **$SrH_2A''_2$,** [*W*], [W hot]. **CaA″3aq,** [W ·839, 15°; ·737, 86°]. **$CaH_2A''_2$,** [W 1·287, 15°; 7·437, 78°]. **MgA″5aq,** [W], (A). **Me_2A'',** [W], [E].

Malonic Acid and Salts. $CH_2(CO_2H)_2$, [134°], [W 109. 1°; 138, 16°; 109, 16°]. [**W**], [**A**], [**E**]; salts of alkalies [W], others [*W*]. **Me_2A'',** [181·5 *cor.*], [A], [E]. **Et_2A'',** (198° cor.), [A], [E].

Mandelic Acid. $C_6H_5.CH(OH).CO_2H$. [115°], [118°]. [W 16, 20°]. [**W**], [**A**], [**E**].

Manganese Compounds. **$MnBr_2$4aq,** [W]. **$MnCl_2$4aq,** [W], [A], (E). **$MnI_2$4aq,** [W], **Oxides** are [acids]. **$KMnO_4$,** S.G. 2·71, [W 6·25, 15°], decomp. by A.

Mannite. $CH_2(OH).[CH(OH)]_4.CH_2(OH)$. [165°]. S.G. 1·5. [W 15·6, 18°], [A ·07, 14°], (E), $(a)_D, = -·25$.

Mannose. CHO.$[CH(OH)]_4$.$CH_2(OH)$. [**W**], [**A**].

Meconic Acid. $C_5HO_2(OH)(CO_2H)_2$. [W 25, 100°], [**A**], [*E*].

Meconin. $C_{10}H_{10}O_4$. [99°], [102·5°]. [W ·5 cold; 5, 100°], [A], [E].

Mellitic Acid. $C_6(CO_2H)_6$. [**W**], [**A**]. **Trimellitic Acid.** $C_6H_3(CO_2H)_3$[1 : 2 : 4]. [218°]. [W], [A], [E].

Menthol. $C_{10}H_{20}O$. [42°]. S.G. $\frac{15}{15}$ ·890. $[a]_D = -59{\cdot}6$, [*W*], [**A**], [**E**], [$\mathbf{CS_2}$], [**HOAc**].

Mercaptan. EtSH. (36·5°). S.G. $\frac{20}{4}$ ·839. H.F.p. 14,430. H.F.v. 13,271. [*W*], [A], [E],

Mercury Compounds. **HgBr,** S.G. 7·3, [c. 405°], (W) (A). $\mathbf{HgBr_2}$, S.G. 5·9, [244°], [W 106, 9°; 20–25, 100°], [**A**], [**E**] [**B** hot] [Acetone]. **HgCl,** (W), (A), (E). $\mathbf{HgCl_2}$, [288°], (303°). S.G. 6·2, [W 5·7, 0°; 6·57, 10°; 11·34, 50°; 53·96, 100°], [A 43·5 cold; 86·2, boil.], [glycerin), [E]. **HgI,** [c. 290°], (310°), [*W*], (A). $\mathbf{HgI_2}$, [238°], (339°–359°), S.G. 6·2 [W ·004, 17·5], [A hot], [E], **Oxides** HgO and Hg_2O are generally [acids]. $\mathbf{HgMe_2}$, (93°–96°), (W), [**A**], [**E**]. $\mathbf{HgEt_2}$, (159°), S.G. 2·46, (W), [*A*], [*E*]. $\mathbf{HgPh_2}$, [120°], (above 300°), (W), [**C**], [$\mathbf{CS_2}$], [**B**], [E], [A boil.].

Mesaconic Acid. $CH_3.C(CO_2H):CH.CO_2H$. [202°]. [W 2·7, 18°; 118, 100°], [A, 90%, 30·6, 17°; 95·7, 78°], [E].

Mesitylene. $C_6H_3Me_3$[1 : 3 : 5]. (164·5). S.G. $\frac{20}{4}$ ·8558. (W), [CS_2].

Mesityl Oxide. $Me_2C:CH.CO.Me$. (132°, 751 mm.). S.G. $\frac{20}{4}$ ·8578. (W), [A] [I].

Mesoxalic Acid. $C_3H_2O_5$aq. [115°], [120°]. [**W**], [A], [E].

Methane CH_4. (*Marsh gas*). [– 155° to – 160°]. H.F.p. 21·750. [W ·05449, 0°], [A ·523, 0°].

Methyl Alcohol. MeOH. (64·8°), (66·2°). S.G. $\frac{15}{15}$ ·79726. H.F.p. 51,450. H.F.v. 50,580. [W], [A], [E].

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Methylamines. $MeNH_2$, (– 6°), the gas is [W 1150, 12·5°] [A]; *Di-*, Me_2NH, (7·2°), [W], [A]; *Tri-*, Me_3N, (3·5°). [W] [A].

Methyl Anilines. PhNHMe, (193° uncor.), S.G. ^{15} ·976, [W]; *Di-*, $PhNMe_2$, [2° – 2·5°] (193°), S.G. $\frac{20}{4}$ ·9575, [A].

Methyl Bromide. MeBr. (4·5°). S.G. $\frac{0}{0}$ 1·732. [A], [E], [C], [CS_2].

Methyl Chloride. MeCl. (– 23·7). S.G. ^{0} ·9523. [W 5·03, 7°], [A 35], [HOAc40].

Methylene Bromide. CH_2Br_2. (97° cor.). S.G. $\frac{15}{15}$ 2·4985. (W), [A]. [E].

Methylene Chloride. CH_2Cl_2. (41·8°). S.G. $\frac{15}{15}$ 1·3377. (W), [A].

Methylene Iodide. CH_2I_2. [4°], (152°, 330 mm.). S.G. $\frac{15}{15}$ 3·2853. (W), [A].

Methyl Iodide. MeI. (42·8°). S.G. $\frac{15}{15}$ 2·2852. [W ·008, 15°]. [A], [E].

Methyl Sulphate. $MeO.SO_2.OH$. [E], [A], [**W**].

Morphine and Salts. $C_{17}H_{19}NO_3$, [230°], S.G. 1·32, [W ·01, 10°; ·22, 100°], [A 90% ·377, 10·6], [E ·023, 10°], [C ·04, 9·4]. Salts: -$B'HCl3aq$, [W 5, cold; 100, 100°]. $B'_2H_2SO_4aq$, [W 4*a*, cold]. $B'HOAc$, [W 50, cold], [A]. $B'_2C_4H_6O_63aq$, (tartrate), [W 11, cold].

Naphthalene. $C_{10}H_8$. [80·2], [79°]. (218°, 760 mm.). S.G. ^{15} 1·152. (W), [*W* hot], [**A**], [**E**], [**HOAc**].

Naphthol. $C_{10}H_7OH$. (*α*)-, [94°], (279°), S.G. ^{4} 1·224, [*W* hot], [**A**], [**E**], [**B**]. (*β*)-, [123°], (286°), S.G. ^{4} 1·217, [W ·02], [A 20%, ·2], [**A**], [**E**], [**C**], [**B**].

Naphthoquinone. $C_{10}H_6O_2$. (*α*)-, [125°], [*W*], [**B**], [**CS_2**], [**C**], [**E**], [**HOAc**], [**A** boil.]. (*β*)-, [A], [E].

Naphthylamine. $C_{10}H_9N$. (*α*)-, [50°]. (300°)., [*W*], [**A**], [**E**]; $B'HCl$, [**W**], [**A**], [**E**]. (*β*)-, [112°], (294°), [W], [A]; $B'HCl$, [**W**], [**A**].

Narceine. $C_{23}H_{29}NO_9$. [134°], [145° cor.], [162°], [W ·08, 13°], [A, 80%, ·1], crys. contg. 2aq are [**W**], [**A**], [*W*], [*C*], (E). *B′HCl,* [W], [A], [W ·36].

Narcotine. $C_{22}H_{23}NO_7$. [155°], [176°] [W ·014, 100°], (W cold), [A, 85%, 1, cold; 5, 78°], [E ·6, 16°; 2·1, boil.], [C 38], [EtOAc 1·7]. *B′HCl,* [**W**], [A contg. HCl].

Nickel Compounds. **$NiBr_2$**, [W], [A], [E]. **$Ni(CO)_4$**, [solid − 25°], (43°, 751 mm.), [A], [B], [C]. **$NiCl_2$**, [**W**], [A], **oxides** (W), [acids]. **NiI_2**, [W].

Nicotine. $C_{10}H_{14}N_2$. (247° cor., 745 mm.), S.G. $^{10}_{4}$ 1·0183, [w], [**A**], [**E**]. *$B''H_2Cl_2$*, [W], [A]. *$B''H_2SO_4$*, [**W**], [**A**].

Nitrates. All normal salts are [W], the greater number are (conc. HNO_3). **$AmNO_3$**, [W c. 200, 18°], [**A**]. **$Ba(NO_3)_2$**, [c. 593°], [W 5, 0°; 9·2, 20°; 32·2, 100°], (A). **$Bi(NO_3)_3xaq$**, decomp. by W. **$Cd(NO_3)_24aq$**, [A]. **$Ca(NO_3)_24aq$**, [A], (E), [AA]. **$Co(NO_3)_26aq$**, [**A**]. **$Cu(NO_3)_23aq$**, [A]. **$Fe(NO_3)_39aq$**, [A]. **$Pb(NO_3)_2$**, [W 39, 0°; 60·6, 25°; 138·9, 100°], [A of S.G. ·9282, 4·96, 4°; 11·49, 50°]. **$LiNO_3$**, [**A**]. **$Mg(NO_3)_26aq$**, [A]. **$Mn(NO_3)_26aq$**, [**A**]. **$2Hg(NO_3)_2aq$**, (A). **KNO_3**, [339°], S.G. ± 2·1, H.F. [K,O,NO_2] 121,485, [W 13·3, 0°; 21, 10°; 31·2, 20°; 85·9, 50; 247, 100°], [*A* of S.G. ·833], (A absol.). **$NaNO_3$**, S.G. ± 2·26, [c. 316°], H.F. [Na,N,O_3] 111,250, [W 72·9, 0°; 80·8, 10°; 112, 50°; 180, 100°], (A absol.), [*A* dil.]. **$Sr(NO_3)_2$**, (A absol.), [*A* dil.]. **$AgNO_3$** [W 121·9, 0°; 227·3, 19·5°; 714, 85°; 1941·4, 133°], [A boil.].

Nitric Acid. HNO_3. [c. − 47°], (86°). S.G. ^{15} 1·552. H.F. [H,N,O_3] 41,510.

Nitrites. **$AmNO_2$**, [W under 50°]. **KNO_2**, [**W**], (A absol.). **$NaNO_2$**, [W], ["spirit"]. **$AgNO_2$**, [W], (A).

Nitro-anilines. $C_6H_4(NO_2).NH_2$; *o*-, [2:1], [71·5°], [**A**], [**E**], [W hot]; *m*-, [3:1], [114°], (285°), [W ·114, 20°], [A 7·05, 20°]; *p*-, [4:1], [147°], [W ·077, 20°], [A 5·84, 20°]; *Di*-, $C_6H_3(NO_2)_2(NH_2)$, [4:2:1], [176°], [A, 95%, ·76, 21°; A, 88%, 5·8], [*W* boil.]; *Tri*-, $C_6H_2(NO_2)_3NH_2$, [6:4:2:1], [188°], [A].

Nitro-benzene. $C_6H_5NO_2$. [3°], (209°, 745 mm.). S.G. $\frac{20}{4}$ 1·2039. (W), [**A**], [**E**].

Nitrogen and Compounds. N, (– 194·4°), S.G. (gas) ·97247 (air = 1), S.G. liq. ·885 at b.p., [W ·01843, 4°; ·0152, 12·6°]; [A ·12561, 1·9°; ·12384, 6·3°; ·12241, 11·2°]. **N_2O,** [– 99°], (– 92°), S.G. (liq.) ·937 at 0°, [W 1·305, 0°; 1·095, 5°; ·92, 10°; ·67, 20°], H.F. [N_2,O] – 17,740. **NO,** [W c. ·05 ord. temp.], [A ·309, 2°; ·282, 11·8°; ·266, 20°], [H_2SO_4, S.G. 1·84, 3·5, 13°], H.F. [N,O] – 21,575. **NO_2 & N_2O_4,** [– 10°], (21·64°, 760 mm.], S.G. liq. $\frac{0}{4}$ 1·4903, H.F. [N,O_2] – 2005, [W with combn.], [C], [EtCl], [CS_2], [$EtNO_2$]. **N_2O_5,** [c. 30°], (45°–50°), S.G. c. 1·64, H.F. [N_2,O_5] – 31,600; [N_2,O_5,Aq] 29,820. **NOCl,** [c. – 8°). *n***NS** (W). [*A*], [*E*], [CS_2].

(*a*) **Nitro-naphthalene.** $C_{10}H_7NO_2$. [56°], [61°], (304°). S.G. $\frac{4}{}$ 1·33. [A, 88%, 2·8].

Nitro-phenols. $C_6H_4(NO_2).OH$. *o*-, [1 : 2], [45°], (214°), [**A**], [**E**], [*W*]; *m*-, [1 : 3], [96°], (194°, 70 mm.), [W hot]; *p*-, [1 : 4], [114°], [W hot], [**A**].

Nitro-toluenes. $C_6H_4MeNO_2$, *o*-, [1 : 2], (218°), S.G. $\frac{15}{}$ 1·168; *m*-, [1 : 3], [16°], (230°), S.G. $\frac{22}{}$ 1·168; *p*-, [1 : 4], [54°], (234°).

Oleic Acid and Salts. $C_{18}H_{34}O_2$, [8°], (223°, 10 mm.), S.G. $\frac{19}{}$ ·808, (W), [**A**], [E]. **KA′**, [W 25, cold]. **NaA′**, [W 10, 12°], [A, of S.G. ·82, 5, 13°], [E boil. 1].

Orcin. $C_6H_3Me(OH)_2$. [1 : 3 : 5]. (c. 228°). [**W**], [**A**], [**E**].

Oxalic Acid and Salts. $H_2C_2O_4$2aq, [187° anhyd.]. $H_2C_2C_4$ is [W 5·3, 10°; 10·2, 20°; 120, 90°], [A 23, 15°], [E 1·27, 15°], H.F. 196,800. **K_2A''aq,** [W 33, 16°]. **Na_2A'',** [W 3, 15°]. **NaHA″aq,** [W 1·7, 15°]. **Li_2A'',** [W 8, 19·5°], (A), (E). **Am_2A''aq,** [W 4·2, 15°]. **Et_2A'',** (186° cor.), S.G. $\frac{15}{15}$ 1·0856, [**A**]. **Oxamide,** $CO(NH_2).CO(NH_2)$, [W ·037, 7·3°].

Oxy-benzoic Acid and Salts. $C_6H_4(OH).CO_2H$. *o*-, (salicylic acid), [156°], [157° cor.], [159° cor.], (sublim. 200°), [W ·09, 0°; ·15, 0°; ·225, 15°; 7·925, 100°], [**E**], [A]. **NaA′,** [**W**], [A]. **$NaHA'_2$,** [W], [A]; *p*-, [213°], [W ·173, 0°; ·8, 15°], [**A**], [**E**], [*C*], [*CS_2*]; *m*-, [200°], [W ·37, 0°; ·9, 18°], [**W** boil.], [**A**].

Oxy-benzoic Aldehyde. $C_6H_4(OH).CHO$. (Salicylic ald.). [c. – 20°], (196·5°). S.G. $\frac{20}{4}$ 1·1671. [*W*], [A], [E].

Oxygen. O, (– 181·4°, 740 mm.). S.G. liq. $\frac{-130}{4}$ ·899. [W ·0489, 0°; ·04286, 5°; ·03802, 10°; ·03415, 15°; ·03103, 20°; ·02616, ·30°]. [A ·28397, 0°–24°]; *Ozone*, O_3, (–106°), [W ·366, 18°, 760 mm,; ·834, 1°; ·2745, 14°].

Palmitic Acid. $C_{16}H_{32}O_2$. [60·75°], (339°–356°). S.G. $\frac{62}{}$ ·853. (W), [A 9·2, 19·5°]. [**A** boil.], [**E** boil.].

Papaverine. $C_{20}H_{21}NO_4$. [147°]. [E ·4, 10], [*W* hot], [**A** hot], [**C** hot], [B hot].

Paraffin Wax. (W), [A hot]. [**E**], [**Oils**].

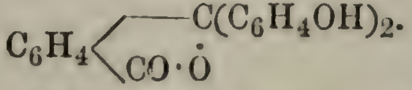
Pelletierine. $C_8H_{13}NO$. (195°). S.G. $\frac{0}{}$ ·998. [W 5], [A], [E], [C].

Pentanes. C_5H_{12}, *n*-, $Me.(CH_2)_3.Me$, (37°), S.G. $\frac{15}{15}$ ·6337; *Iso*-, $Me_2CH.CH_2.CH_3$, (30°), S.G. $\frac{15}{15}$ ·6248.

Phenanthraquinone. $C_{14}H_8O_2$. [202°], (above 360°). [*W*], [*W* hot], [*A* cold], [A hot], [E], [HOAc], [B].

Phenanthrene. $C_{14}H_{10}$. [100°], [103°], (340° i. V.). [A 2·62, 16°; 10·08, 78°], [**E**], [**B**], [**HOAc**], [**CS_2**].

Phenol. C_6H_5OH. [41°], (181·5°), (182·9°). S.G. $\frac{20}{4}$ 1·0702. [W 6·6, 17°]. H.F. 47,341. [A], [E].

Phenol-phthaleïn. 

$$C_6H_4\left\langle\begin{array}{l}C(C_6H_4OH)_2.\\CO\cdot\dot{O}\end{array}\right.$$

[c. 253°]. [**A** hot]. [*W*].

Phenyl-hydrazine. $NHPh.NH_2$. [23°], (241·5° i. V., 750 mm.). [*W* hot], [A], [E], [B], [C].

TABLE OF MELTING AND BOILING POINTS, SOLUBILITY, ETC.—*continued.*

Phenyl Mercaptan. PhSH. (168°), (172°). S.G. $\underline{24}$ 1·078. [**A**], [**E**].

Phenyl-thiocarbamide. $C_6H_5N.CS$. (220°, 750 mm.). S.G. $\frac{4}{4}$ 1·059. Decomp. with most solvents. [C].

Phloretin. $C_{15}H_{14}O_5$. [255°]. [*W* hot], [*E*], [**A**].

Phlorizin. $C_{21}H_{24}O_{10}2aq$. [109° anhy.] S.G. $\underline{19}$ 1·43. [W ·1, cold], [*W*], [**W** hot], [**A**], (E).

Phloroglucin.. $C_6H_3(HO)_3[1:3:5]$. [219°]. [**W**], [**A**], [**E**].

Phosphates. The normal and acid salts of H_3PO_4 with alkali metals are [W]. **$AlPO_4$ xAq,** [acids], [KHO soln.]. **Am_2HPO_4,** [W], (A). **$Ca_3P_2O_8$,** [Min. acids], [*W*]. **Na_2HPO_412Aq,** [W 2·5, 0°; 3·9, 10°; 9·3, 20°; 82·5, 50°; 99·4, 100°], (A). **$Na_4P_2O_7$,** (*pyro.-phos.*), [W 3·0, 0°; 3·95, 10°; 6·23, 20°; 40·26, 100], (A).

Phosphoric Acid. H_3PO_4. [41·75]. S.G. 1·88. H.F. [P,O_4,H_3 to solid acid] 302,600. [W, *V.* Tab., p. 212].

Phosphorus and Compounds. P. *Ordinary crys.* P, [44·3°], (290°), (287·3, 762 mm.), [*W*], [*A*], [*E*], [**CS_2**], [**S_2Cl_2**], [liq. **P_2S**]. *Amorph. red.* P is insol. in menstrua which dissolve the ord. variety. **PBr_3,** (172·9°, 760·2 mm.), S.G. $\frac{0}{4}$ 2·923, decomp. by W. **PCl_3,** (75·95°, 760 mm.), S.G. $\frac{0}{4}$ 1·613, [B], [E], [C], [CS_2]. **PCl_5,** [148° under pressure], (160°–165° with part. decomp.), decomp. by W. **PH_3,** Liquefies −90°; solidifies −133·5°; melts −132·5°, (c. −85°), [W ·112], [*A*], [*E*], [*eth. oils*], [Cu_2Cl_2 in HClAq]. **P_2H_4,** (57°–58°, 735 mm.), S.G. 1·007 to 1·016, (W). **P_2I_4,** (PI_2), [110°], [CS_2]. **PI_3,** [55°], [CS_2]. **P_2O_5,** S.G. 2·387, H.F. [P_2,O_5] 369,900; [P_2,O_5,Aq] 35,600, [W forming HPO_3]. **$POCl_3$,** [−1·5°], (107·2°), S.G. $\frac{0}{4}$ 1·7116, decomp. by W.

Phthalic Acid. $C_6H_4(CO_2H)_2[1:2]$. [184°], [203°]. [W ·54, 14°; 18, 99°], [A 10, 15°], [E ·684, 15°], (C).

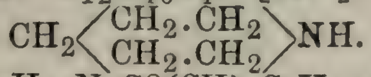
Phytosterin. $C_{26}H_{44}O.aq$. [132°–133°], [136°–137°]. [**A** hot], [**E**], [**C**], (W).

Picric Acid. $C_6H_2(NO_2)_3$ OH[6 : 4 : 2 : 1] [122°] [W 5°, ·626 ; 20°, 1·22 ; 77°; 3·89] [**A**] [**E**].

Picrotoxin. [*W*], [*E*], [*C*], [**A**], [Alkalis].

Pilocarpine. $C_{11}H_{16}N_2O_2$. B′HCl, [**A**].

Piperic Acid. $C_{12}H_{10}O_4$. [217°]. [A ·37, cold ; 2, 78°], [*W*], [E].

Piperidine.  $CH_2\left\langle\begin{matrix}CH_2.CH_2\\CH_2.CH_2\end{matrix}\right\rangle NH$. (106°). S.G. $\frac{15}{15}$ ·8664. [w].

Piperine. $C_5H_{10}N.CO(CH)_4C_6H_3:O_2CH_2$. [128°]. [*W hot*], [A], [E], (dil. acids or alkalies).

Piperonal. *V.* Protocatechnic Aldehyde.

Platini Compounds.—Bromides. **Am_2PtBr_6**, S.G. 4·2, [W 20°, ·59] ; **K_2PtBr_6**, S.G. 4·54, [W 20°, 2·07 ; 100°, 10] ; **Na_2PtBr_6 6aq**, S.G. 3·323. [**W**], [**A**]. **-chlorides.** **Am_2PtCl_6**, S.G. 3·065, [W 20°, ·665 ; 100°, 1·25], [*hot A*], [*E hot*] ; **K_2PtCl_6**, S.G. 3·586 [W 0°, ·74 ; 20°, 1·12 ; 100°, 5·13], [*A*], [*A + E*], [*Acids*]. [KHOAq].

Platino Compounds.—Bromides. **K_2PtBr_4** [**W**].**-Chlorides.** **Am_2 $PtCl_4$** [**W** hot] (A) **K_2PtCl_4**. S.G. $^{21°}$ 3·29 [**W**] (A).

Platinum Compounds. **$PtBr_2$**, (W), (*A*), (*E*), [HBrAq], [KBrAq]. **$PtBr_4$**, [*A*], [*E*], [*W*], [*glycerin*]. **$PtCl_2$**, S.G. ^{11} 5·87, (W), (A), (E), [HClAq hot minus air]. **$PtCl_4$**, [**W**], [A], [E]. **PtF_4**, [W with decomp.]. **PtI_2** (W), (A), (Acids). **PtI_4**, (W), [A with partl. decomp.], [HIAq], [Iodides]. *Platodiammine chloride*, $Pt(NH_3.NH_3Cl)_2$.aq, [W 16·5°, 25], (A), (E).

Potassium Compounds. **KBr**, S.G. 2·7, [699°], [**W**] (*A*). **KCl**, S.G. ^{15} 1·94, [734°], [W 10°, 32 ; 15°, 33·4 ; 50°, 42·8 ; 100°, 56·6], (A), (HClAq conc.). **KHF_2**, [**W**]. **KHS**, [**W**]. [**A**]. **KHO**, S.G. 2·1 [**W**], [**A**], (*E*). **KI**, [634°], [W 10°, 136·1 ; 20°, 144·2 ; 50°, 168 ; 100°, 209], [A], (*E*). **KI_3**, [45°], [A], [small quantity of W].

Propane. $CH_3.CH_2.CH_3$. (–17°). [A 6].

Propargyl Alcohol. $CH \vdots C.CH_2OH$. (115°). S.G. $\frac{20}{4}$ ·9715. [W].

Propionic Acid and Salts. $CH_3.CH_2.CO_2H$. [−23°], (140·7° cor.). S.G. $\frac{15}{15}$ ·9983. [w], [a], [e], [b], [ligroin]. **NaA′**, [W 15°, 99; 100°, 187], [A 20°, 2·4; 100°, 3]. **KA′**, [W 16°, 178; 100°, 309]. **CaA′$_2$aq**, [W 17°, 54; 80°, 39], (A).

Propionitrile. EtCN. (97°). S.G. $\frac{0}{4}$ ·801. [**W**], [a], [e].

Propionic Aldehyde. $CH_3.CH_2.CHO$. S.G. $\frac{15}{15}$ ·8065. [W], [A], [ligroin].

Propyl Alcohols. *n*-, $CH_3.CH_2.CH_2OH$, (97·4° i. V.), S.G. $\frac{15}{15}$ ·8088, [w], [A]; *iso*-, $(CH_3)_2CH.OH$, (83° cor.), S.G. $\frac{15}{15}$ ·7914, [w], [A].

Propylamines. *n*-, $CH_3.CH_2.CH_2.NH_2$, (49°), S.G. $\frac{15}{15}$ ·7222, [w], [A]; *iso*-, $(CH_3)_2CH.NH_2$, (32°), S.G. $\underline{18}$ ·690, [w], [A].; **Di-*n*-**, Pr_2NH, (110°), (98°), S.G. $\frac{15}{15}$ ·7430 [*W*]; **Di-iso**, Ᵽr_2NH, (84°), S.G. $\underline{22}$ ·722, [w].

Propyl Compounds. **PrBr**, (71°), S.G. $\frac{15}{15}$ 1·361, [A]. **ᵽrBr**, (60°), S.G. $\frac{15}{15}$ 1·3198, [A]. **PrCl**, (46° i. V.), S.G. $\frac{15}{15}$ ·893, [A]. **ᵽrCl**, (36°), S.G. $\frac{15}{15}$ ·8688, [A]. **PrI**, (102·5°), S.G. $\frac{15}{15}$ 1·7585, [A]. **ᵽrI**, (89°), S.G. $\frac{15}{15}$ 1·7163, [A].

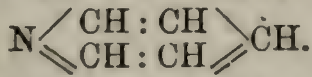
Propylene Glycol. $C_3H_6(OH)_2$. (189°). S.G. $\frac{0}{0}$ 1·0527. [w], [a], [E 11].

Proteids. *Albumins* (e.g. egg. alb., serum alb., lactalb., vegetable alb.), C.,* [W], [conc. NaCl or $MgSO_4$]. *Globulins* (e.g. serum glob., cell glob., fibrinogen, myosin, vitellin, crystallin, hæmoglobin, hæmocyanin, vegetable glob.), C.,* [W], [dil. solns. neutr. salts], (pptd. but not coag. by NaCl or $MgSO_4$). *Albuminates* (i.e. acid alb., alkali alb.), N.C.,* (W), (solns. neutr. salts), (dil. acids or dil. alkalies). *Proteoses*, (mostly intermediate compds. in formation of peptones from proteids), N.C.,* [W], (mostly pptd. by certain neutr. salts), (pptd. by HNO_3Aq). *Peptones*, N.C.,* [**W**], [solns. neutr. salts], [HNO_3Aq], (pptd. by tannin), (pptd. by A), (pptd. by pot. merc. iod.). *Insoluble proteids*, Fibrin, (W), (dil. HCl); Lardacein, (W); Gluten, (W), [dil. HCl], [strong acids or alkalies]. *Proteid-like Compounds*, Gelatin, (cold W), [hot W], (A), (E), (C); Mucin, [dil. CaOAq or BaOAq], (pptd. by acetic acid), (A); Keratin, (W), (A), (E), (dil. acids), [boil. alkalies].

* C. = coagulated. N.C. = not coagulated by heat.

Protocatechuic Acid. $C_6H_3(OH)_2.CO_2H$[4:3:1]. [199°], [194°]. [W 14°, 1·9; 60°, 10], [A], [E], (B).

Protocatechuic Aldehyde, &c. $C_6H_3(OH)_2.CHO$[4:3:1], [150°], [**W** hot], [**A**], [**E**]. *Vanillin*, $C_6H_3(OMe)(OH).CHO$, [81°], (285°), [W 14°, 1; 80°, 5], [**A**], [E], [C], [CS_2], [hot ligroin]. *Piperonal*, $CH_2O_2:C_6H_3.CHO$, [37°], (263°), [W cold ·2], [W hot], [**A**], [**E**].

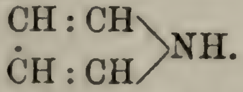
Pyridine. 

$N\begin{smallmatrix}\diagup CH:CH \diagdown \\ \diagdown CH:CH \diagup\end{smallmatrix}CH$. (116°). S.G. $\frac{15}{15}$ ·9855. [w], [A], [C].

Pyrocatechin. $C_6H_4(OH)_2$[1:2]. [104°], [111°], (240°–245°). [**W**], [**A**], [**E**], [B], [C], (ligroin).

Pyrogallol. $C_6H_3(OH)_3$[1:2:3]. *Pyrogallic acid*, [131°], [134°], (210°), [W 12°, 40], [A], [E].

Pyrotartaric Acid. $CO_2H.CHMe.CH_2.CO_2H$. *Methyl-succinic acid*, [115°], [W 20°, 66], [**A**], [E].

Pyrrole. 

$\begin{matrix}CH:CH\\ \dot{C}H:CH\end{matrix}\Big\rangle NH$. (130 i. V.). S.G. $\frac{12\cdot5}{}$ ·9752. [**A**], [**E**].

Pyruvic Acid. $CH_3.CO.CO_2H$. *Di-oxy-propionic acid*, [9°], (c. 165°), S.G. $\frac{15}{15}$ 1·2752, [**W**], [**A**], [**E**].

Quassin. [211°]. [W 22°, ·252], [C 15°, 48], (*E*), [conc. HClAq], [conc. KOHAq].

Quercetin. [Above 250°]. [A 78°, 5·5; cold, ·4], [*W*], [*E*].

Quercitannic Acid. [W ·6], [E ·035].

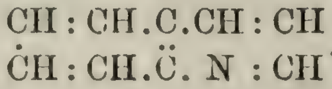
Quercite. $C_6H_{12}O_5$. [234°]. [W 12°, 9; 20°, 11], (E), (B), (C), [*A hot*].

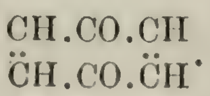
Quercitrin. [168°]. [W cold, ·04; 100°, ·7], [A cold, 4; 78°, 29], [E ·8].

Quinic Acid. $C_6H_7(OH)_4.CO_2H$. [162° cor.]. [W 9°, 40], [A], [*E*].

Quinine. $C_{20}H_{24}N_2O_2$. [173° cor.]. [(trihydrate) W 15°, ·06; 100°, ·11], [(anhydrous) W 15°, ·051; 100°, ·13], [E 10°, 100; 18°, ·44], [C 57·5], [B 15°, ·5; 80°, 3·3], [Xylene 15°, ·11; 138°, ·645], [**CS_2**], [**A**], [*ligroin*], [oils, fix. and vol.].

Salts. *B′HCl2aq*, [160°], [W 10°, 2·5], [**A**], [**E**]. *B′2HCl*, [15°], [W cold, 100], *$B'H_2Br_23aq$*, [**W**]. BHI, [*W*], [**A**]. *$B'_2H_2SO_48aq$*, [of anhy. W 6°, 126; 100°, 3], [A, S.G. ·85, 1], [glycerin, 2·5], (C). *$B'H_2SO_47aq$*, [W 13°, 9; 22°, 12·5]. *$B'(H_2SO_4)_27aq$*, [**W**], [A].

Quinoline.  $\begin{array}{l}CH:CH.C.CH:CH\\ \dot{C}H:CH.\ddot{C}.\ N\ :CH\end{array}$. (237·5°), (234°), (241° cor.). S.G. $\underline{0}$ 1·107. [*W*], [A], [E], [CS_2].

Quinone.  $\begin{array}{l}CH.CO.CH\\ \ddot{C}H.CO.\ddot{C}H\end{array}$. [116°]. [*W*], [A], [E], [HClAq], [conc. HNO_3].

Raffinose. $C_{18}H_{32}O_{16}5aq$. [c. 87°]. [W 16°, 17; 20°, 14], [A of 80% 70°, 1·4].

Resins. The following are [A of 95%]:—Benzoin, caranna, conifer resins, dragon's blood, guaiacum, mani-resin, mastic (Bombay and Alexandria), black balsam Peru, sandarac, balsam Tolu, xanthorrhœa resin. These are partially [A of 95%]:—Ammoniac, asafœtida, bdellium, Canada balsam, ceradia resin, copaiba balsam, copal, dammar, elemi, euphorbium, galbanum, gamboge, liquidambar, common mastic, Mecca balsam, myrrh, olibanum, opopanax, white balsam Peru, sagapenum, liquid storax. The following are [E]:—Caranna, Canada balsam, conifer resins, copaiba balsam, dragon's blood, elemi, guaiacum, mastic, sandarac. Most other resins are partly [E].

Resorcin. $C_6H_4(OH)_2[1:3]$. [112°], (267°). [W 0°, 86·4; 30°, 228·6], [**W**], [**A**], [**E**], (C). (CS_2).

Ricinoleïc Acid. $C_{18}H_{34}O_3$. [17°]. [A], [E].

Rosaniline. ([4 : 1]$C_6H_4(NH_2))_2C(OH).C_6H_3Me(NH_2)$[1 : 3 : 4], [*W*]. [*$NH_3Aq$*], [A], (E). *Para-rosaniline*, ([1 : 4]$C_6H_4(NH_2)_3COH$, *W* [conc. HClAq].

Rubidium Compounds. RbBr, [c. 683°], [W 5°, 98 ; 16°, 104·8]. **RbCl**, [c. 710°], [W 1°, 76·38 ; 7°, 82·89], [A]. **RbI**, [c. 642°], [W 6·9°, 137·5 ; 17·4°, 152]. **RbOH**, [**W**], [A].

Saccharic Acid. $CO_2H.(CHOH)_4.CO_2H$. [**W**], [**A**], [*E*].

Saccharin. *V.* Sulphobenzoic Imide.

Salicin. $C_6H_{11}O_5.O.C_6H_4.CH_2OH$. [201°]. [W 11°, 3·3], [A], (E).

Santonin. $C_{15}H_{18}O_3$. [170°]. S.G. ^{22} 1·247. [W 17·5°, ·02 ; 100°, ·4], [A 22·5°, 2·3 ; 50°, 8 ; 80°, ·37], [E 40°, 2·4], [C 23].

Saponin. [**W**], (A), (E).

Scoparin. $C_{21}H_{22}O_{10}$. [*W*], [W hot], [A], [alkalies].

Scutellarin. (W), [**A**], [**E**].

Selenates. Am_2SeO_4, [W]. **$BaSeO_4$**, (W), (HNO_3Aq). **$CaSeO_4 2aq$**, [W]. **K_2SeO_4**, [W].

Selenion Compounds. Se_2Br_2, [CS_2], [C]. **$SeBr_4$**, [CS_2], [C], [EtBr]. **Se_2Cl_2**, [**CS_2**], [**C**], [**B**], [**CCl_4**]. **$SeCl_4$**, (*CS_2*). **SeO_2**, [A 96%], (*Acetic anhyd. boil.*).

Silica. SiO_2. S.G. (quartz) 2·647 to 2·652. Insol. in all solvents except such as react. Dissolved by HF ; also by alkalies, the crys. slowly, the amorph. more quickly.

Silicon Compounds. Si_2Br_6, (c. 240°). **$SiBr_4$**, S.G. ^{0} 2·8128, [solidify c. – 12°], (153·4°, 762·5 mm.). **Si_2Cl_6**, S.G. ^{0} 1·58 (146°–148°). **$SiCl_4$**, S.G. ^{0} 1·5241, (57·57°, 760 mm.), decomp. by W or A. **SiF_4**, (liqfy. – 106·5°, 9 atmos.). **SiH_4**, (liqfg. – 11°, 50 atmos.), (– 1°, 100 atmos.), (W). **SiI_4**, [120·5°], (290°), decomp. by W, A, or E.

Silver Compounds. **AgBr,** [c. 434°], (W). **AgCl,** [c. 457], S.G. ^{0} 5·5, S.G. ^{0} 5·67, *W, cold or hot,* dissolves an appreciable amount, but not in presence of ·05 gr. per litre of $AgNO_3$; the granular or fused form is (W cold), [conc. HClAq], [*conc. chlorides of alk. and alk. earths*], [NH_3Aq]. **AgI,** [c. 530°], S.G. $\frac{0}{5\cdot67}$, (W), (*NH_3Aq*).

Sodium Compounds. **NaBr,** [708°], [727°], S.G. $^{17\cdot5}$ 3·079; $^{17\cdot3}$ 3·198, [W 0°, 77·5; 20°, 88·4; 100°, 114·9], [A, 90%, 6], (*Acetone*). **NaCl,** [772°], [851°], S.G. ^{0} 2·16, [W 0°, 35·52; 50°, 36·98; 100°, 39·61], (A absol.), [A, S.G. ·9282, 4°, 10·9; 10°, 11·1; 60°, 14·1], (*A* + *E*), (Acetone). **NaF,** [W 16°, 4·78], (*A*). **NaOH,** [1098°], S.G. 2·13, S.G. 1·723, [W cold, c. 212], [**A**], (*E*). **NaI,** [628°], [650°], S.G. 3·45–3·65, [W 20°, 178·6; 60°, 256·4; 140°, 333·3. *V.* p. 219], [**A**], (*E*).

Solanine. [244°]. [**A** 85%], (C), (ligroin), [*E*], [*W*].

Sparteine. $C_{15}H_{26}N_2$. (311°, 760 mm.). [A], [E], (B), (ligroin).

Starch. $nC_{12}H_{20}O_{10}$ (n is $>$ 100). (W). Soluble starch is [W], (A).

Stearic Acid. $C_{18}H_{36}O_2$. [69°], (232° cor., 15 mm.), (359°–383°). S.G. ^{80} ·845; ^{10} 1·00. [A cold 2·5], [B 23°, 22], [CS_2 30], (W), [E].

Strontium Compounds. **$SrBr_2$,** [c. 630°], [W], (*A*). **$SrCl_2$,** [825°], S.G. ^{0} 2·96, [W 0°, 44·2; 10°, 48·3; 100°, 101·9], (A absol.). **SrO_2H_2,** S.G. 3·62, [W]. **SrI_2,** S.G. 4·41, [W].

Strophanthin. [W], [**A**], (E).

Strychnine. $C_{21}H_{22}N_2O_2$. [221°], [284°], [268°], [269°], (270°, 5 mm.). [W cold, ·015; 100°, ·04], [A 8°, ·3; 78°, 1·8], [A 95%, ·936], [E ·08], [B ·607], [iso-amyl alcoh. 12°, ·53; 99°, 4·3.

Styrene. $C_6H_5.CH:CH_2$, (144°), S.G. $^{20}_{4}$ ·9074, [A], [E]. *Metastyrene*, $(C_8H_8)_x$, S.G. ^{13} 1·054, (W), (A), [*E*].

Suberic Acid. $C_8H_{14}O_4$. [140°], (c. 300°). [W 15, ·142], [E 15°, ·8].

Succinic Acid. $CO_2H.CH_2.CH_2.CO_2H$. [182°], [185°], (261°). S.G. 1·55. [W 0°, 2·88; 14·5°, 5·14; 100°, 121], [A 15°, 7·5], [E 15°, 1·25].

Sugars. *Dextrose*, $C_6H_{12}O_6$, [**W**], contg. —aq is [A], [MeHO]; anhyd. is insol. in same. *Lævulose.* $C_6H_{12}O_6$, [**W**], [*A*], [A + E boil.]. *Galactose*, $C_6H_{12}O_6$, [163°–164°], [**W**], [*MeHO*]. *Sorbose*, $C_6H_{12}O_6$, [**W**]. *Mannose*, $C_6H_{12}O_6$, [W], [A], (E). *Saccharon*, (common sugar), $C_{12}H_{22}O_{11}$, [160°], S.G.$^{17·5}_{17·5}$ 1·580, [**W**]. [A], [MeHO], [acetone], [glycerin]. *Lactose*, $C_{12}H_{22}O_{11}.H_2O$, S.G. 1·53, [**W**]. *Maltose*, $C_{12}H_{22}O_{11}.H_2O$, [*A*, S.G. ·84], [MeHO], [W].

Sulphates. **$Al_2(SO_4)_3.(NH_4)_2SO_4.24aq$**, S.G. 1·56, [W 0°, 5·22; 100°, 421·9], (A). **$Al_2(SO_4)_3.K_2SO_4 24aq$**,, S.G. 1·7, [W 0°, 3·29; 60°, 31; 100°, 357], (A). **Am_2SO_4**, [c. 140°], S.G. 1·76, [W 0°, 71; 20°, 76·3; 100°, 97·5], (A), (*A*, S.G. ·872). **$BaSO_4$**, (W). **$CaSO_4$**, [W 0°, ·19; 20°, ·206; 60°, ·208; 100°, ·174]. **$CdSO_4aq$**, [W], (A). **$CuSO_4 5aq$** [W 0°, 31·6; 50, 65·8; 100°, 203·3] (A) [A 40%, 15°, ·25]. **$PbSO_4$**, S.G. 6·2, (W), (*conc.* H_2SO_4), (*dil.* HCl), (*dil.* HNO_3). **Li_2SO_4**, [818°], [W 0°, 35·34; 20°, 34·36; 100°, 29·24], [**A**]. **$MgSO_4 7aq$**, [70°], [W 0°, 25·76; 15°, 33·8; 100°, 73·8], [A 10%, 15°, 39·3; 40%, 15°, 1·62]. **$MnSO_4 4aq$**, [W 10°, 63·8; 100°, 52·9], (A). **$NiSO_4$**, [W 16°, 37·4; 70°, 61·9], (*A*). **K_2SO_4**, [W 10°, 9·7; 50°, 15·8; 100°, 26·2], (A). **Ag_2SO_4**, [645°], [W cold, 1·15; 100°, 1·45]. **Na_2SO_4**, [861°], [W 0°, 5; 34°, 78·8; 100°, 42·7; 230°, 46·4], (A). **$ZnSO_4$**, sol. of – 7 aq, [W 0°, 115·2; 20°, 161; 100°, 653·6], (A).

Sulphites. Sulphites of alkali metals are [W], as are acid salts of alkaline earth metals. Most other salts are (W).

Sulphobenzoic Imide. (Saccharin). [220°]. [*W*], [W hot], [**A**], [**E**].

Sulphonal. $Me_2C(SO_2Et)_2$. [125°]. [*A*], (W).

Sulphur. S. [c. 115°]. (W), [CS_2 0°, 23·99; 15°, 37·15; 55°, 181·34], (*A* boil.), (*E* boil.), [B boil.], (*C*). *V.* p. 227 for other data.

Sulphur Compounds. **S_2Cl_2**, (138·12°), S.G. $\frac{0}{4}$ 1·709; $\underline{\text{BP}}$ 1·492], [CS_2], [B]. **SCl_2**, S.G. $\underline{15\cdot4}$ 1·648, [B], [A A glac.]. **SO_2**, [c. − 76°], (c. − 10°), S.G. $\underline{-20:5}$ (liq.) 1·4384; $\underline{20}$ 1·3769, [W], [A], [A A glac.]. **SO_3**, [14·8°], (46·2°), S.G. $\underline{20}$ 1·94. **$SOCl_2$**, (78·5°), S.G. $\frac{0}{0}$ 1·6767. **SO_2Cl_2**, (69·95°), S.G. $\frac{0}{0}$ 1·708°.

Sulphuric Acid, H_2SO_4, [10·35°], (begins c. 290°, constant at 338° with dissoc.), S.G. $\frac{15}{15}$ 1·8884, S.H. 22°–80°, ·335, H.F. [H_2,S,O_4] = 192,920 : [$H_2O.SO_3$] = 21,320, [w]. **Pyrosulphuric Acid,** $H_2S_2O_7$, [35°].

Tannic Acids. Gallotannic acid, $C_{14}H_{10}O_6$, [acetone], [glycerin], [oils], (C), (CS_2), (B), (petroleum). Tannic acid (oak bark), $C_{17}H_{16}O_9$, [A], [acet. ether], [*W*], [*E*].

Tartaric Acids and Salts. $CO_2H(CHOH)_2CO_2H$, [135°, changing to isomer.), S.G. $\frac{7}{4}$ 1·7594, [W 0°, 115; 15° 132; 100°, 343], [A 15°, 25·6], [E 15°, ·4]. **Am_2A''**, [W]. **$AmHA''$**, [*W* cold]. **$K_2A''\frac{1}{2}aq$**, [W 2°, 133; 23°, 158], [*A* hot]. **KHA''** (cream of tartar), [W 0°, ·25; 10°, ·4; 20°, ·55; 40°, 1·13], (A). **$Na_2A''2aq$**, [W 6°, 29; 24°, 44; 42·5°, 66], (A). **$NaHA''aq$**, [W cold, 11; 100°, 55], (A). **$KNaA''4aq$** (Rochelle salt), W 3°, 30; 26°, 66]. **$K(SbO)A''\frac{1}{2}aq$** (tartar emetic), [W 8°, 5; 21°, 8; 100°, 52], (A). **Racemic Acid,** $C_6H_6O_6$, [206°], S.G. $\frac{7}{4}$ 1·778, [W 0°. 8·16; 20°, 18; 100°, 137·8]. **Lævotartaric acid,** [170°]. **Inactive T.A.,** [140°–143°], [W 15°, 125].

Taurine. $CH_2(NH_2).CH_2.SO_3H$. [W 12°, 6·5], (A).

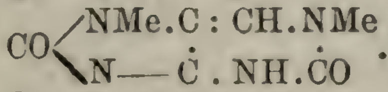
Tellurium Compounds. **H_2TeO_4**, S G. $\underline{18\cdot8}$ 3·425, [W boil.], (A), (E). **$TeBr_2$**, [c. 305°], (c. 343°). **$TeBr_4$**, S.G. $\frac{15}{4}$ 4·31, [224°] (414°). **$TeCl_2$**, [209°], (327°). **$TeCl_4$** [224°], (414°). **TeO_2**, S.G. 5·7, [*W*], [most acids], [KHOAq].

Terephthalic Acid. $C_6H_4(CO_2H)_2$. [*W*], [*E*], [*C*], [*A A*].

Terpenes. $C_{10}H_{16}$. **Pinene,** dextro-, (156°), S.G. $\frac{0}{4}$ ·8765; $\frac{25}{25}$ ·8586; lævo.-, (156·5°), S.G. $\frac{0}{0}$ ·8767. **Limonene,** dextro.-, (175°–176°), S.G. $\frac{20}{20}$ ·846; lævo.-, (175°–176°), S.G. $\frac{20}{20}$ ·846. **Sylvestrene,** (176°–177°), S.G. $\frac{14}{16}$ ·851. **Thellandrene,** (171°–172°). **Dipentene,** (c. 176°). **Fenchene,** (190°–193°).

Thallium Compounds. **TlBr,** [458°], (*W*). **$TlBr_3$,** [**W**], [**A**]. **TlCl,** [427°], (708°–719°), [*W*], (A), (NH_3Aq). **$TlCl_3$,** [**W**]. **Tl_2Cl_3,** [W 15°, ·26; 17°, ·29; 100°, 1·9]. **TlOH,** [W], [A]. **TlO.OH,** (W), (dil. alkali). **TlI,** [439°], (800°–806°), [*W*], (A).

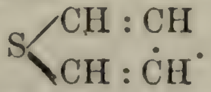
Thebaïne. $C_{19}H_{21}NO_3$. [193°]. S.G. 1·3 [**A**]. [**C**], [E 10°, ·7], [B].

Theobromine.  $CO\begin{cases}NMe.C:CH.NMe\\ N—C.NH.CO\end{cases}$. [W 17°, ·062; 100°, ·7], [**A** 17°, ·02; 78°, ·2], [E cold, ·006; 35°, ·17], [C boil., 1].

Thialdine. $C_6H_{13}NS_2$. [43°]. [*W*], [**A**], [**E**].

Theine. *V.* Caffeine.

Thio-carbamide. *V.* Thio-urea.

Thiophene.  $S\begin{cases}CH:CH\\ CH:CH\end{cases}$. (84°). S.G. $\frac{15}{4}$ 1·0705.

Thiosulphate of Sodium. $Na_2S_2O_3.5aq$. *S.G.* ^{10} 1·736. [45°], [48·5]. [**W** 0°, 49·75; 20°, 69·44; 40°, 104·16; 60°, 192·3], *v.* p. 234, (A).

Thio-urea. $CS(NH_2)_2$. [170°]. [W cold, 9], [*A*], [*E*].

Thymol. $C_6H_3MePr.OH[5:2:1]$. [49·5°], (232°). S.G. $\frac{0}{0}$ ·9941. [W ·3], [**A**], [**E**], [**HOAc**].

Tin Compounds. **$SnBr_4$**, [30°], [33°], (201°), (203·3°), S.G. 3·35, [W cold]. **$SnBr_2$**, [215·5°], (617°–634°), S.G. $\frac{17}{}$ 5·117. **$SnCl_2$**, [249·3°], (617°–628°), (606°) [W]. **$SnCl_4$**, [solidfy. – 33°], (113·9°, 760 mm.), S.G. $\frac{0}{4}$ 2·2787, [W]. **SnI_2**, [316°], [*W cold*], [W hot]. **SnI_4**, [146°] (295°), S.F. ^{11} 4·696, [CS_2, 15°, 145], [A], [B], [E]. **SnO_2**, crys., S.G. $\frac{4}{}$ 7·0096, (acids). **$K_2SnO_3.xaq$**, (K stannate), [**W**], (A). **$NaSnO_3xaq$**, [W 0°, 67·4; 20°, 61·3], (A).

Toluene. $C_6H_5.CH_3$. (109°), (111°). S.G. $\frac{20}{4}$ ·8656; $\frac{13}{4}$ ·8708.

Toluidine. *o*-, $C_6H_4Me.NH_2$[1:2], (198°), S.G. $\frac{20}{4}$ ·9986, [A], [E], [H_2SO_4aq]; *m*-, [1:3], (197°), (201°), (205°), S.G. ^{25} ·998, [A], [E], [H_2SO_4aq]; *p*-, [1:4], [45°], [42·8°], (198°), (206°), S.G. 1·046, [W 11·5°, ·35], [A], [E], [H_2SO_4aq], [ligroïn].

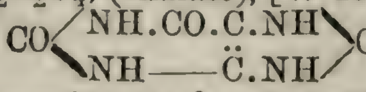
Toluquinone. $C_6H_3MeO_2$[2:4:1]. [69°]. [W hot], [**A**], [**E**].

Tropine. $C_8H_{15}NO$. [62°], (229°). [**W**], [**A**], [E].

Tungsten Compounds. **WBr_5**, [276°], (333°). **WCl_6**, [275°], (346·7°, 760 mm.), [**CS_2**], [**$POCl_3$**]. **WCl_5**. [248°], (275·6°), [*CS_2*]. **WO_3**, S.G. amorph. 7·13–7·16; crys. $\frac{17}{}$ 7·23, (W), (acids), [alkalies hot or molten].

Tyrosine. $C_6H_4(OH).CH_2.CH(NH_2).CO_2H$. [235°]. S.G. 1·456. [W 20°, ·04; 100°, ·65], [A 90%, cold, ·0074], (E), [NH_3Aq], [KOHAq].

Urea. $CO(NH_2)_2$, [132°], S.G. 1·323, [**W**], [A cold, 20; 78°, 100], (C), [*E*]. $B'HNO_3$, [*W*], [*A*]. $B'_2H_2C_2O_4$, (oxalate), [W 15°, 4·4], [A, S.G. ·833, 1·65], [**W** hot].

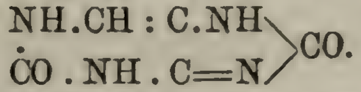
Uric Acid. 
$CO\left<\begin{matrix}NH.CO.C.NH\\NH——\ddot{C}.NH\end{matrix}\right>CO$. S.G. 1·87. [W 0°, ·002; 20°, ·006; 100°, ·0625], (A), (E), [glycerin], [carbonates of K and Li], [piperazine].

Valeric Acids. *n*-, $CH_3(CH_2)_3CO_2H$, (186° cor.), S.G. $\frac{15}{15}$ ·9446, [W 16°, 3·5]; Iso-, $Me_2CH.CH_2.CO_2H$, (176° cor.), S.G. $\frac{15}{15}$ ·9336, [*W*], [A], [E]; Active-, $CHMeEt.CO_2H$, (177° i. V.), S.G. $\frac{24}{17 \cdot 5}$ ·938; Tertiary-, $CMe_3.CO_2H$, [35°], (163·5° i. V.), [W 20°, 2·2].

Valeric Aldehyde. Iso-, $Me_2CH.CH_2.COH$. (92·5°). S.G. $\frac{15}{15}$ ·8041. [A], [E].

Vanillin. *V.* Protocatechnic Aldehyde.

Veratrine. $C_{32}H_{49}NO_9$. [205°]. [W 15°, ·12], [A], [E].

Xanthine. 

$$\left.\begin{array}{l} NH.CH : C.NH \\ \dot{C}O\,.\,NH\,.\,C{=}N \end{array}\right\rangle CO.$$

[W cold, ·007; 100°, ·08], (A), (E), [KHOAq].

Xylene. *o*-, $C_6H_4Me_2$[1 : 2], [− 28°], (142°), S.G. $\frac{0}{0}$ ·8932; *m*-, [1 : 3], (139°), S.G. $\frac{0}{0}$ ·8812; *p*-, [1 : 4], [13°], (138°), S.G. $\frac{0}{0}$ ·8801.

Zinc Compounds. **ZnBr**, S.G. ^{10} 3·643, [394°], (695°–699°), [**W**], **A**, [**E**]. **$ZnCl_2$**, [262°], (708°–719°), S.G. ^{13} 2·753, [**W**], [**A**], [**Acetone**]. **ZnF_2**, S.G. ^{15} 4·84, (*W* cold), [W hot], (A). **ZnI_2**, [446°], (c. 624°), S.G. 4·696, [W]. **ZnO**, amorph., S.G. 5·5–5·7; crys., ^{15} 5·782, (W), [acids]. **$Zn(Me)_2$**, [− 40°], (46), S.G. $^{10·5}$ 1·386. **$Zn(Et)_2$**, [− 8°], (118°), S.G. ^{18} 1·182.

TABLE OF MELTING AND BOILING POINTS, ETC.

CONTRACTIONS.

The contractions used in this table are the same as those elsewhere used in the Pocket-Book with some additional contractions to express solubility.

W = water. A = alcohol. C = chloroform. B = benzene. E = ether. AA = acetic acid.

[Solvent] = soluble in solvent.

[Solvent, 0° temp., x] x = number of grms. of substance dissolved by 100 grms. of solvent at 0° C. Temperature is not always stated.

[**Solvent**] = very soluble, or easily soluble, in solvent. *Note.*—Egyptian type in square brackets are used.

[SOLVENT] = miscible with solvent. *Note.*—Small capitals in square brackets are used.

(*Solvent*) [*Solvent*] = sparingly soluble, nearly insoluble. *Note.*—Italics are used in square or round brackets.

(Solvent) = insoluble in solvent. *Note.*—Round brackets are used.

Examples.

"[**W**] (*A*) (E) [B] [C $a_D = + 161$] [CS_2, 10°, 23 ; 50°, 80]" means, very sol. in water, sparingly sol. in alcohol, insol. in ether, miscible with benzene, sol. in chloroform, with specific rotatory power of + 161 to the right for the D line, sol. in carbon bisulphide, of which 100 grms. dissolve 23 grms. at 10° C., and 80 grms. at 50° C.

"[A S.G. ·84, 60, 15°]" means, sol. in alcohol of sp. gr. ·84, 60 grms. being dissolved by 100 grms. of the solvent at 15° C.

"[A 95%, 10°, 21·2]" means, sol. in alcohol cntg. 95 per cent. of C_2H_6O, &c., &c.

"The greater number are (conc. HNO_3) and (HCl)" means, the greater number are insol. in conc. HNO_3, and insol. in HCl.

NOTE.—Where discordant statements of M.P., B.P., &c., exist, the several values are sometimes given.

Besides the abbreviations referred to on this page, others are sometimes used, the meaning of which is obvious from the context ; as dissoc. for dissociation, &c., &c.

TABLE SHOWING THE SOLUBILITY OF LEAD IN WATER IN THE PRESENCE OF VARIOUS SALTS.

Name of Salt in Solution.	Grams per Litre.	Grains per Gallon.	Lead Dissolved.					
			Milligrams per Litre.			Grains per Gallon.		
			24 hours.	48 hours.	72 hours.	24 hours.	48 hours.	72 hours.
Ammonium Nitrate ..	·02	1·4	13	..	35	·91	..	1·75
„ „	·04	2·8	15	15	32	1·05	1·05	2·24
„ „	·08	5·6	15	..	..	1·05	..	..
Potassium Nitrate	·02	1 4	2	2	..	·14	·14	..
Sodium Sulphate ..	·05	3·5						
Potassium Nitrate ..	·04	2·8	·8	1	1·2	·05	·07	·08
Sodium Sulphate ..	·212	14·7						
Potassium Nitrate ..	·045	3·1	..	..	·3	..	..	·021
Sodium Carbonate ..	·308	21·5						
Potassium Nitrate ..	·078	5·4	..	..	·5	..	..	·035
Potassium Carbonate	·504	35·2						
Calcium Sulphate	·252	17·5	·4	..	·8	·02	..	·05
„ „	·458	28·5	·4	..	1·0	·02	..	·07
Potassium Carbonate	·31	21·7	..	..	·2	..	..	·014
„ „	·516	36·1	..	..	·2	..	..	·014
Calcium Chloride ..	·25	17·5	·5	·5	·5	·04	·04	·04
„ „	·51	35·7	·3	..	·4	·028	..	·028
Sodium Sulphate ..	·20	14·0	..	..	·8	..	..	·05
„ „	·40	28·0	..	..	·5	..	..	·03
Ammonium Nitrate ..	·02	1·4	..	..	1·8	..	..	·126
Calcium Nitrate	·06	4·2						

TABLE SHOWING THE SOLUBILITY OF LEAD—*continued*.

Name of Salt in Solution.	Grams per Litre.	Grains per Gallon.	Lead Dissolved.					
			Milligrams per Litre.			Grains per Gallon.		
			24 hours.	48 hours.	72 hours.	24 hours.	48 hours.	72 hours.
Ammonium Chloride	·02	1·4	..	..	·4	..	..	·028
Potassium Carbonate	·10	7·0						
Sodium Sulphite ..	·20	14·0						
Sodium Sulphate ..	·20	14·0	..	..	·1	..	..	·007
Potassium Carbonate	·04	2·8						
Calcium Chloride	·10	7·0						
Loch Katrine	..	..	1	1	1·5	·07	·07	·105
Distilled water	..	..	2	2	3	·15	·15	·21

SOLUBILITY OF AIR IN WATER.

1 Vol. of Water dissolves under a pressure of 760 mm. and at t. °C.		1 Vol. of Water dissolves under a pressure of 760 mm. and at t. °C.		1 Vol. of Water dissolves under a pressure of 760 mm. and at t. °C.	
Temp,	Volume of Air.	Temp.	Volume of Air.	Temp.	Volume of Air.
0	·02471	7	·02080	14	·01822
1	·02406	8	·02034	15	·01795
2	·02345	9	·01992	16	·01771
3	·02287	10	·01953	17	·01750
4	·02237	11	·01916	18	·01732
5	·02179	12	·01882	19	·01717
6	·02128	13	·01851	20	·01704

Coefficients of Solubility of some Gases in Water and in Alcohol.

Gas.	0° C.	4° C.	10° C.	15° C.	20° C.
Nitrogen in water	·02035	·01838	·01607	·01478	·01403
„ „ alcohol	·12634	·12476	·12276	·12142	·12038
Hydrogen „ water	·01930	·01930	·01930	·01930	·01930
„ „ alcohol	·06925	·06867	·06786	·00725	·066668
Oxygen „ water	·04114	·03717	·03250	·02989	·02838
„ „ alcohol	·28397	·28397	·28397	·28397	·28397
Carbonic anhydride „ water	1·7987	1·5126	1·1847	1·0020	·9014
„ „ „ alcohol	4·3295	3·9736	3·5140	3·1993	2·9465
Carbonic oxide „ water	·03287	·02987	·02635	·02432	·02312
„ „ „ alcohol	·20443	·20443	·20443	·20443	·20443
Nitrous oxide „ water	1·3052	1·1346	·9196	·7778	·6700
„ „ „ alcohol	4·1780	3·9085	3·5408	3·2678	3·0253
Nitric oxide „ water	·31606	·30290	·28609	·27478	·26592
Marsh gas „ water	·05449	·04993	·04372	·03909	·03499
„ „ „ alcohol	·52259	·51135	·49535	·48280	·47096
Olefiant gas „ water	·2568	·2227	·1837	·1615	·1488
„ „ „ alcohol	3·5950	3·3750	3·0859	2·8825	2·7131
Butane „ water	·03147	·02770	·02355	·02147	·02065
Ethane „ water	·0874	·0748	·0599	·0508	·0447
Hydrogen sulphide „ water	4·3706	4·0442	3·5858	3·2326	2·9053
„ „ „ alcohol	17·891	15·373	11·992	9·539	7·415
Sulphurous anhydride „ water	79·789	69·828	56·647	47·276	39·374
„ „ „ alcohol	328·62	265·81	190·31	144·55	114·48
Ammonia „ water	1049·6	941·9	812·8	727·2	654·0
Air „ water	·02471	·02237	·01953	·01795	·01704

TABLE SHOWING THE BOILING POINTS OF SATURATED SOLUTIONS.

Salt in Solution.	Boiling Point °C.	Salt per 100 of Water.
Potassium acetate ..	169	800
Sodium ,, ..	124·4	209
Potassium carbonate ..	135	205
Sodium ,, ..	104·6	48·5
Ammonium chloride ..	114·2	89
Barium ,, ..	104·4	60
Calcium ,, ..	179·5	325
Potassium ,, ..	108·4	59·4
Sodium ,, ..	108·4	40·2
Ammonium nitrate ..	164	209
Calcium ,, ..	151	362
Potassium ,, ..	116	335
Sodium phosphate ..	106·6	112·6

Solubility of Anthracene and its Associates.

(A) G. von Bechi; (B) W. H. Perkin; (C) General.

A

—	100 p. Toluene dissolve at 15° C.	100 p. Toluene dissolve at 100° C.	100 p. Abs. Alcohol dissolve at 15° C.	100 p. Abs. Alcohol dissolve at 100° C.
Naphthalene..	31·94	∞	5·29	∞
Phenanthrene	33·02	∞	2·62	10·08
Anthracene ..	·92	12·94	·076	·83
Pyrene	16·54	v. sol.	1·37	3·08
Chrysene ..	·24	5·39	·097	·17
Anthraquinone	·19	2·56	·05	2·25
Carbazol.. ..	·55	5·46	·92	3·88
Imido-phenyl-aphthyl ..	scarcely sol.	·39–·57	scarcely sol.	·25

B

—	100 p. Petroleum Spirit (70°–100° C.) dissolve.	100 p. Coal-tar Naphtha (80°–100° C.) dissolve.
Phenanthrene .	3·207	21·94
Anthracene . .	·115	·976
Dichloranthracene	·157	·52
Anthraquinone .	·013	·166
Carbazol . . .	·016	·51

C

Solvent.	Anthracene. Grams per 100 cm.³ at 15° C.	Solvent.	Anthracene. Grams per 100 cm.³ at 15° C.
Alcohol, S. G. ·800	·472	Ether	·858
" " ·825	·424	Chloroform . .	2·587
" " ·830	·408	Carbon disulphide	1·180
" " ·835	·397	Glac. Acet. Acid.	·472
" " ·840	·387	Benzene . . .	1·470
" " ·850	·360	Petrol spirit . .	·291

E. H. WALDO —

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS.

From Allen's 'Commercial Organic Analysis.'

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHO Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Ethyl alcohol	C_2H_6O	∞	∞	∞	∞	∞	∞	∞	S	∞	∞	Any contained water is separated by excess of 5 last solvents.
Amyl alcohol	$C_5H_{12}O$	2½	..	2½	∞	∞	∞	∞	∞	∞	∞	Soluble in acetic acid mixed with equal volume of water.
Glycerin.. ..	$C_3H_8O_3$	∞	∞	∞	∞	..	I	I	I	I	I	
Nitroglycerin	$C_3H_5N_3O_9$	I	I	I	S	..	S	..	..	..	..	Decomposed by boiling soda solution. Soluble in wood spirit.
Ether	$C_4H_{10}O$	10	..	10	∞	∞	∞	∞	∞	∞	∞	
Chloral hydrate.	$C_2HCl_3O_1H_2O$	67	S	(S)	S	..	S	S	S	S	S	Decomposed by soda with separation of chloroform.

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS—*continued.*

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHo Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Chloroform ..	$CHCl_3$	I	I	I	S	∞	∞	∞	∞	∞	∞	
Iodoform ..	CHI_3	I	I	I	1¼	..	S	S	S	(S)	(S)	Dissolved by 13,000 parts of cold water.
Acetic acid ..	$C_2H_4O_2$	∞	∞	∞	∞	∞	(S)	..	..	..	..	Soluble in ether only when anhydrous.
Oxalic acid (crystallised).	$C_2H_2O_4, 2\,H_2O$	8	350	S	15	..	(I)	I	..	I	I	Soluble in ether to extent of 1¼ per cent.
Lactic acid ..	$C_3H_6O_3$	∞	∞	S	∞	S	∞	(S)	..	..	..	
Succinic acid ..	$C_4H_6O_4$	8	60	S	12½	..	15	I	..	I	..	Soluble in 13 parts absolute alcohol. Decomposed on boiling.
Tartaric acid..	$C_4H_6O_6$	25	100	S	41	..	(I)	I	..	I	I	Soluble in ether to extent of 4 per cent. Decomposed by fusion.
Citric acid ..	$C_6H_8O_7, H_2O$	133	200	S	53	..	2½	I	..	I	I	Absolute alcohol dissolves 39 per cent.

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS—*continued.*

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHO Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Meconic acid..	$C_7H_4O_7, 3H_2O$	·9	S	S	12	..	I	..	..	..	..	Soluble in about 150 parts of ether.
Gallic acid ..	$C_7H_6O_5, H_2O$	I	33	S	23	..	$2\frac{1}{2}$	..	..	..	..	Decomposed by heat. Very soluble in absolute alcohol.
Pyrogallic acid	$C_6H_6O_3$	33	S	S	S	..	S	I	..	..	..	Solution in soda turns rapidly brown in air.
Gallotannic acid.	Indefinite	S	S	S	S	..	(I)	I	I	I	I	Soluble in acetic ether.
Sulphophenic acid.	$C_6H_6SO_4$	S	S	S	S	..	I	I	..	..	..	Decomposed on boiling.
Picric acid ..	$C_6H_3N_3O_7$	I	S	S	S	S	S	S	S	S	S	
Benzoic acid ..	$C_7H_6O_2$	$\frac{1}{2}$	8	S	42	..	31	S	S	S	S	
Salicylic acid..	$C_7H_6O_3$	(I)	S	S	42	..	50	..	..	S	..	Very slightly soluble in cold water.
Phthalic acid..	$C_8H_6O_4$	$\frac{4}{5}$	S	S	S	..	S	..	..	S	..	

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS—*continued.*

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHO Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Chrysophanic acid.	$C_{15}H_{10}O_4$	I	(I)	S	S	..	S	S	..	S	S	Alkaline solution is purple-red.
Hippuric acid	$C_9H_9NO_3$	¼	S	S	S	..	I	I	..	I	..	
Uric acid ..	$C_5H_4N_4O_3$	I	I	S	I	..	I	..	..	..	..	
Higher fatty acids.	Various	I	I	S	S	S	S	S	S	S	S	Aqueous and alkali solutions precipitated by excess of soda.
Fixed oils ..	Various	I	I	I	(I)	S	S	S	S	S	S	Castor oil is soluble in spirit and insoluble in petroleum ether.
Oil of turpentine	$C_{10}H_{16}$	I	I	I	∞	S	∞	∞	∞	∞	∞	
Camphor ..	$C_{10}H_{16}O$	I	I	I	S	..	S	S	S	..	..	
Paraffin wax ..	C_nH_{2n2+2}	I	I	I	(I)	..	S	S	S	S	S	Soluble in hot absolute alcohol, insoluble in cold.
Benzene	C_6H_6	I	I	I	∞	S	∞	∞	S	∞	∞	

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS—*continued.*

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHO Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Nitrobenzene..	$C_6H_5NO_2$	I	I	I	∞	..	∞	..	..	∞	..	
Naphthalene..	$C_{10}H_8$	I	I	I	S	..	S	S	S	S	S	Sparingly soluble in cold spirit, ether, or benzene.
Anthracene ..	$C_{14}H_{10}$	I	I	I	(S)	..	S	S	S	S	(I)	
Alizarin	$C_{14}H_8O_4$	I	(I)	S	S	..	S	..	S	S	..	Slightly soluble in hot water.
Aurin	$C_{19}H_{14}O_3$	I	I	S	S	..	S	I	I	I	S	Slightly soluble in water. Alkaline solutions red.
Indigotin ..	$C_{16}H_{10}N_2O_4$	I	I	I	I	S	I	S	S	I	..	Soluble in hot aniline, phenol, and creasote, and in strong sulphuric acid.
Carbolic acid (absolute).	C_6H_6O	8½	S	S	∞	..	∞	∞	∞	∞	S	Sparingly soluble in cold petroleum spirit.
Resorcinol ..	$C_6H_6O_2$	S	S	S	S	..	S	I	I	(S)	..	Soluble in hot benzene; deposited on cooling.

TABLE SHOWING THE BEHAVIOUR OF VARIOUS ORGANIC SUBSTANCES WITH SOLVENTS—*continued.*

Name of Substance.	Formula.	Solubility in 100 Parts of										Remarks. (The sign ∞ signifies that the substance and solvent are miscible in all proportions).
		Cold Water.	Boiling Water.	10 per cent. NaHO Solution.	Rectified Spirit.	Amylic Alcohol.	Ether.	Chloroform.	Carbon Disulphide.	Benzene.	Petroleum Ether.	
Orcinol	$C_7H_6O_2+H_2O$	S	(S)	..	S	..	S	..	..	S	..	Soluble with difficulty in hot water and in alkaline solutions.
Thymol	$C_{10}H_{14}O$	(I)	..	S	100	..	S	..	..	..	..	Insoluble in small quantities of soda. Soluble in 1000 of water.
Menthol	$C_{10}H_{20}O$	I	I	I	S	..	S	..	..	S	..	
Creasote (mixture).	$C_8H_{10}O_2$; &c.	..	I	(S)	S	..	∞	∞	∞	∞	∞	Soluble with difficulty in soda. Insoluble in ammonia.

TABLE SHOWING THE BEHAVIOUR OF ORGANIC SUBSTANCES WITH IMMISCIBLE SOLVENTS.

From Allen's 'Commercial Organic Analysis.'

On agitating the substance with water, acidulated with sulphuric acid, and a suitable solvent immiscible therewith (such as ether, chloroform, amylic alcohol, benzene, or petroleum ether), the following distribution will occur:—

THE ACIDULATED AQUEOUS LIQUID will contain *carbohydrates, soluble alkaloids and acids, organic bases, proteids,* &c., which may be further separated by adding a moderate excess of soda, and again shaking with a suitable immiscible solvent, when there will be obtained:—		THE IMMISCIBLE LAYER will contain *hydrocarbons, oils, various acids, resins, colouring matters, phenols, glucosides,* &c., which may be further separated by agitating the liquid with water containing caustic soda, when there will be obtained:—	
IN THE ALKALINE AQUEOUS LIQUID—	IN THE IMMISCIBLE LAYER—	IN THE ALKALINE AQUEOUS LIQUID—	IN THE IMMISCIBLE LAYER—
Carbohydrates; as sugars, gums, dextrin. *Soluble Alcohols;* as methyl alcohol, ethyl alcohol, glycerin. *Soluble Acids;* as acetic, oxalic, lactic, malic, tartaric, sulphophenic. *Certain Alkaloids or Organic Bases;* as curarine, urea, glycocine, solanine, and possibly cinchonine, morphine, and pyridine. *Certain Colouring Matters;* as indigo products. *Proteids and their Allies;* as albumin, casein, gelatin.	*Most Vegetable Alkaloids;* as quinine, strychnine, aconitine, atropine, nicotine, (cinchonine, morphine, the last two with difficulty). *Coal Tar Bases;* as aniline and its homologues (rosaniline), chrysotoluidine (pyridine), homologues of pyridine.	*Fatty Acids;* as stearic, oleic, valeric. *Various other Acids,* as benzoic, salicylic, phthalic, meconic. *Acid Dyes and Colouring Matters;* as picric and chrysophanic acids, alizarin, aurin, bilirubin. *Acid Resins;* as colophony. *Phenols;* as carbolic and cresylic acids, thymol, creasote. *Certain Glucosides, &c.;* as santonin, cantharidin, picrotoxin.	*Solid Hydrocarbons;* as paraffin, naphthalene, anthracene. *Liquid Hydrocarbons;* as petroleum products, rosin-oil, benzene. *Essential Oils;* as turpentine. *Nitro-compounds;* as nitrobenzene. *Ethers and their Allies;* as ether, chloroform, compound ethers, nitro-glycerin. *Fixed Oils, Fats, and Waxes.* *Neutral Resins and Colouring matters.* *Camphors;* as laurel-camphor, borneol, menthol. *Alcohols* insoluble or nearly insoluble in water; as amyl and cetyl alcohols, cholesterin. *Certain Glucosides, &c.;* as saponin, digitalin, santonin. *Certain Weak Alkaloids;* as caffeine, colchicine, narcotine, piperine, theobromine.

SECTION VII.

EUDIOMETRY.

To reduce the volume of a gas to the standard temperature and pressure, 0° C. and 760 mm. barometric pressure.

V^0 = volume required.
V = volume observed.
t = temperature observed (° C.).
B = pressure observed in mm. From B the tension of aqueous vapour at the observed temperature expressed in mm. of mercury must be deducted.

$$V^0 = \frac{V}{1 + \delta t} \cdot \frac{B}{760} = \frac{V \times B}{760\,(1 + \delta t)}.$$

In the following section Tables are given for the values of $1 + \delta t$, of $760\,(1 + \delta t)$, of $\frac{B}{760}$, and of $\log. \frac{\cdot 0012934}{760\,(1 + \delta t)}$.

The last table is of use in calculations of the density of air (i.e. weights of 1 cm^3 in g) = D, according to the formula

$$D = \frac{\cdot 0012934}{1 + \delta t} \cdot \frac{B}{760}.$$

In the tables δ is taken either as ·003665 or ·00367.

The tables, pp. 309–332, may often be used to avoid calculating.

FORMULA FOR REDUCING VOLUME OF GAS MEASURED IN A EUDIOMETER.

V′ = correct volume.
V = volume found in the table, and corresponding to the observed height of the mercury in the eudiometer, the meniscus error being included.
B = height of barometer.
B′ = difference of level between the two surfaces of mercury.
t = temperature in °C.
T = tension of aqueous vapour in mm. of mercury.

Then $V' = \dfrac{V \times (B - B' - T)}{760 \times (1 + \cdot 003665\, t)}$ where 760 mm. is taken as the normal pressure; if 1000 mm. is taken, substitute 1000 for the 760 in the above formula.

TABLE FOR CORRECTION OF VOLUMES OF GASES FOR TEMPERATURE ACCORDING TO THE FORMULA

$$V^1 = \frac{V \times B}{760 \times (1 + \delta t)}.$$

$1 + \delta t$ from 0° to 30°. $\delta = 0{\cdot}003665$.

t	$1 + \delta t$.	Log. $(1 + \delta t)$.	t	$1 + \delta t$.	Log. $(1 + \delta t)$.
°			°		
0·0	1·0000000	0·0000000	2·6	1·0095290	0·0041188
·1	1·0003665	1591	·7	1·0098955	2765
·2	1·0007330	3182	·8	1·0102620	4341
·3	1·0010995	4772	2·9	1·0106285	5916
·4	1·0014660	6362	3·0	1·0109950	0·0047490
0·5	1·0018325	7951	·1	1·0113615	9063
·6	1·0021990	9519	·2	1·0117280	0·0050636
·7	1·0025655	0·0011127	·3	1·0120945	2210
·8	1·0029320	2714	·4	1·0124610	3782
·9	1·0032985	4301	3·5	1·0128275	5354
1·0	1·0036650	0·0015888	·6	1·0131940	6926
·1	1·0040315	7474	·7	1·0135605	8497
·2	1·0043980	9059	·8	1·0139270	0·0060067
·3	1·0047645	0·0020643	3·9	1·0142935	1636
·4	1·0051310	2227	4·0	1·0146600	0·0063205
1·5	1·0054975	3810	·1	1·0150265	4773
·6	1·0058640	5393	·2	1·0153930	6341
·7	1·0062305	6974	·3	1·0157595	7909
·8	1·0065970	8556	·4	1·0161260	9476
1·9	1·0069635	0·0030137	4·5	1·0164925	0·0071042
2·0	1·0073300	0·0031718	·6	1·0168590	2607
·1	1·0076965	3298	·7	1·0172255	4172
·2	1·0080630	4877	·8	1·0175920	5736
·3	1·0084295	6455	4·9	1·0179585	7300
·4	1·0087960	8033	5·0	1·0183250	0·0078864
2·5	1·0091625	9611	·1	1·0186915	0·0080427

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$1+\delta t$.	Log. $(1+\delta t)$.	t	$1+\delta t$.	Log. $(1+\delta t)$.
°			°		
5·2	1·0190580	0·0081989	8·3	1·0304195	0·0130141
·3	1·0194245	4551	·4	1·0307860	1685
·4	1·0197910	5112	8·5	1·0311525	3229
5·5	1·0201575	6672	·6	1·0315190	4772
·6	1·0205240	8232	·7	1·0318855	6315
·7	1·0208905	9791	·8	1·0322520	7857
·8	1·0212570	0·0091350	8·9	1·0326185	9399
5·9	1·0216235	2908	9·0	1·0329850	0·0140940
6·0	1·0219900	0·0094466	·1	1·0333515	2481
·1	1·0223565	6023	·2	1·0337180	4021
·2	1·0227230	7580	·3	1·0340845	5561
·3	1·0230895	9136	·4	1·0344510	7100
·4	1·0234560	0·0100692	9·5	1·0348175	8638
6·5	1·0238225	2247	·6	1·0351840	0·0150175
·6	1·0241890	3802	·7	1·0355505	1712
·7	1·0245555	5356	·8	1·0359170	3249
·8	1·0249220	6909	9·9	1·0362835	4785
·9	1·0252885	8461	10·0	1·0366500	0·0156321
7·0	1·0256550	0·0110013	·1	1·0370165	7857
·1	1·0260215	1565	·2	1·0373830	9392
·2	1·0263880	3116	·3	1·0377495	0·0160926
·3	1·0267545	4666	·4	1·0381160	2459
·4	1·0271210	6216	10·5	1·0384825	3992
7·5	1·0274875	7765	·6	1·0388490	5524
·6	1·0278540	9314	·7	1·0392155	7056
·7	1·0282205	0·0120862	·8	1·0395820	8587
·8	1·0285870	2410	10·9	1·0399485	0·0170118
7·9	1·0289535	3957	11·0	1·0403150	0·0171648
8·0	1·0293200	0·0125504	·1	1·0406815	3178
·1	1·0296865	7050	·2	1·0410480	4707
·2	1·0300530	8596	·3	1·0414145	6236

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$1 + \delta t$.	Log. $(1+\delta t)$.	t	$1 + \delta t$.	Log. $(1+\delta t)$.
°			°		
11·4	1·0417810	0·0177764	14·5	1·0531425	0·0224871
11·5	1·0421475	9292	·6	1·0535090	6382
·6	1·0425140	0·0180819	·7	1·0538755	7893
·7	1·0428805	2346	·8	1·0542420	9403
·8	1·0432470	3872	14·9	1·0546085	0·0230193
11·9	1·0436135	5397	15·0	1·0549750	0·0232422
12·0	1·0439800	0·0186922	·1	1·0553415	3930
·1	1·0443465	8446	·2	1·0557080	5438
·2	1·0447130	9970	·3	1·0560745	6945
·3	1·0450795	0·0191493	·4	1·0564410	8452
·4	1·0454460	3016	15·5	1·0568075	9959
12·5	1·0458125	4538	·6	1·0571740	0·0241465
·6	1·0461790	6060	·7	1·0575405	2970
·7	1·0465455	7581	·8	1·0579070	4475
·8	1·0469120	9102	15·9	1·0582735	5979
12·9	1·0472785	0·0200622	16·0	1·0586400	0·0247483
13·0	1·0476450	0·0202141	·1	1·0590065	8986
·1	1·0480115	3660	·2	1·0593730	0·0250489
·2	1·0483780	5179	·3	1·0597395	1991
·3	1·0487445	6697	·4	1·0601060	3492
·4	1·0491110	8214	16·5	1·0604725	4993
13·5	1·0494775	9731	·6	1·0608390	6494
·6	1·0498440	0·0211248	·7	1·0612055	7994
·7	1·0502105	2764	·8	1·0615720	9494
·8	1·0505770	4279	16·9	1·0619385	0·0260993
13·9	1·0509435	5794	17·0	1·0623050	0·0262492
14·0	1·0513100	0·0217308	·1	1·0626715	3990
·1	1·0516765	8821	·2	1·0630380	5488
·2	1·0520430	0·0220334	·3	1·0634045	6985
·3	1·0524095	1847	·4	1·0637710	8482
·4	1·0527760	3359	17·5	1·0641375	9978

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$1 + \delta t$.	Log. $(1+\delta t)$.	t	$1 + \delta t$.	Log. $(1+\delta t)$.
°			°		
17·6	1·0645040	0·0271474	20·7	1·0758655	0·0317580
·7	1·0648705	2968	·8	1·0762320	9058
·8	1·0652370	4462	20·9	1·0765985	0·0320538
17·9	1·0656035	5956	21·0	1·0769650	0·0322016
18·0	1·0659700	0·0277450	·1	1·0773315	3493
·1	1·0663365	8943	·2	1·0776980	4971
·2	1·0667030	0·0280435	·3	1·0780645	6447
·3	1·0670695	1927	·4	1·0784310	7924
·4	1·0674360	3418	21·5	1·0787975	9399
18·5	1·0678025	4909	·6	1·0791640	0·0330874
·6	1·0681690	6399	·7	1·0795305	2349
·7	1·0685355	7889	·8	1·0798970	3824
·8	1·0689020	9379	21·9	1·0802635	5298
18·9	1·0692685	0·0290868	22·0	1·0806300	0·0336771
19·0	1·0696350	0·0292356	·1	1·0809965	8244
·1	1·0700015	3844	·2	1·0813630	9716
·2	1·0703680	5331	·3	1·0817295	0·0341187
·3	1·0707345	6818	·4	1·0820960	2658
·4	1·0711010	8304	22·5	1·0824625	4129
19·5	1·0714675	9790	·6	1·0828290	5599
·6	1·0718340	0·0301275	·7	1·0831955	7069
·7	1·0722005	2760	·8	1·0835620	8538
·8	1·0725670	4244	22·9	1·0839285	0·0350007
19·9	1·0729335	5728	23·0	1·0842950	0·0351475
20·0	1·0730000	0·0307211	·1	1·0846615	2943
·1	1·0736665	8694	·2	1·0850280	4410
·2	1·0740330	0·0310176	·3	1·0853945	5877
·3	1·0743995	1658	·4	1·0857610	7343
·4	1·0747660	3139	23·5	1·0861275	8809
20·5	1·0751325	4620	·6	1·0864940	0·0360274
·6	1·0754990	6100	·7	1·0868605	1739

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$1+\delta t$.	Log. $(1+\delta t)$.	t	$1+\delta t$.	Log. $(1+\delta t)$.
°			°		
23·8	1·0872270	0·0363203	27·0	1·0989550	0·0409800
23·9	1·0875935	4666	·1	1·0993215	0·0411248
24·0	1·0879600	0·0366129	·2	1·0996880	2696
·1	1·0883265	7592	·3	1·1000545	4143
·2	1·0886930	9054	·4	1·1004210	5589
·3	1·0890595	0·0370516	27·5	1·1007875	7035
·4	1·0894260	1978	·6	1·1011540	8481
24·5	1·0897925	3439	·7	1·1015205	9926
·6	1·0901590	4899	·8	1·1018870	0·0421371
·7	1·0905255	6359	27·9	1·1022535	2815
·8	1·0908920	7818	28·0	1·1026200	0·0424259
24·9	1·0912585	9276	·1	1·1029865	5702
25·0	1·0916250	0·0380734	·2	1·1033530	7145
·1	1·0919915	2192	·3	1·1037195	8587
·2	1·0923580	3649	·4	1·1040860	0·0430029
·3	1·0927245	5106	28·5	1·1044525	1470
·4	1·0930910	6563	·6	1·1048190	2911
25·5	1·0934575	8019	·7	1·1051855	4352
·6	1·0938240	9474	·8	1·1055520	5792
·7	1·0941905	0·0390929	28·9	1·1059185	7232
·8	1·0945570	2384	29·0	1·1062850	0·0438671
25·9	1·0949235	3838	·1	1·1066515	0·0440110
26·0	1·0952900	0·0395291	·2	1·1070180	1548
·1	1·0956565	6744	·3	1·1073845	2986
·2	1·0960230	8197	·4	1·1077510	4423
·3	1·0963895	9649	29·5	1·1081175	5859
·4	1·0967560	0·0401101	·6	1·1084840	7295
26·5	1·0971225	2552	·7	1·1088505	8730
·6	1·0974890	4003	·8	1·1092170	0·0450165
·7	1·0978555	5453	29·9	1·1095835	1600
·8	1·0982220	6902			
26·9	1·0985885	8351	30·0	1·1099500	0·0453035

TABLE FOR CORRECTION OF VOLUMES OF GASES FOR TEMPERATURE, GIVING THE DIVISOR FOR THE FORMULA

$$V^1 = \frac{V \times B}{760 \times (1 + \delta t)}.$$

t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.	t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.
°			°		
0·0	760·0000	2·8808136	2·6	767·2420	2·8849324
·1	760·2785	9727	·7	767·5206	2·8850901
·2	760·5571	2·8811318	·8	767·7991	2477
·3	760·8356	2908	·9	768·0777	4052
·4	761·1142	4498	3·0	768·3562	2·8855626
0·5	761·3927	6087	·1	768·6347	7199
·6	761·6712	7675	·2	768·9133	8772
·7	761·9498	9263	·3	769·1918	2·8860345
·8	762·2283	2·8820850	·4	769·4704	1918
·9	762·5069	2437	3·5	769·7489	3490
1·0	762·7854	2·8824024	·6	770·0274	5062
·1	763·0639	5610	·7	770·3060	6633
·2	763·3425	7195	·8	770·5845	8203
·3	763·6210	8779	·9	770·8631	9772
·4	763·8996	2 8830363	4·0	771·1416	2·8871341
1·5	764·1781	1946	·1	771·4201	2909
·6	764·4566	3528	·2	771·6987	4477
·7	764·7352	5111	·3	771·9772	6045
·8	765·0137	6692	·4	772·2558	7612
·9	765·2923	8273	4·5	772·5343	9178
2·0	765·5708	2·8839854	·6	772·8128	2·8880743
·1	765·8493	2·8841434	·7	773·0914	2308
·2	766·1279	3013	·8	773·3699	3872
·3	766·4064	4591	·9	773·6485	5436
·4	766·6850	6169	5·0	773·9270	2·8887000
2·5	766·9635	7747	·1	774·2055	8563

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.	t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.
°			°		
5·2	774·4841	2·8890125	8·3	783·1188	2·8938277
·3	774·7626	1687	·4	783·3974	9821
·4	775·0412	3248	8·5	783·6959	2·8941365
5·5	775·3197	4808	·6	783·9544	2908
·6	775·5982	6368	·7	784·2330	4451
·7	775·8768	7927	·8	784·5115	5993
·8	776·1553	9486	·9	784·7901	7535
·9	776·4339	2·8901044	9·0	785·0686	2·8949076
6·0	776·7124	2·8902602	·1	785·3471	2·8950617
·1	776·9909	4159	·2	785·6257	2157
·2	777·2695	5716	·3	785·9042	3697
·3	777·5480	7272	·4	786·1828	5236
·4	777·8266	8828	9·5	786·4613	6774
6·5	778·1051	2·8910383	·6	786·7398	8311
·6	778·3836	1938	·7	787·0184	9848
·7	778·6622	3492	·8	787·2969	2·8961385
·8	778·9407	5045	·9	787·5755	2921
·9	779·2193	6597	10·0	787·8540	2·8964457
7·0	779·4978	2·8918149	·1	788·1325	5993
·1	779·7763	9701	·2	788·4111	7528
·2	780·0549	2·8921252	·3	788·6896	9062
·3	780·3334	2802	·4	788·9682	2·8970595
·4	780·6120	4352	10·5	789·2467	2128
7·5	780·8905	5901	·6	789·5252	3660
·6	781·1690	7450	·7	789·8038	5192
·7	781·4476	8998	·8	790·0823	6723
·8	781·7261	2·8930546	·9	790·3609	8254
·9	782·0047	2093	11·0	790·6394	2·8979784
8·0	782·2832	2·8933640	·1	790·9179	2·8981314
·1	782·5617	5186	·2	791·1965	2843
·2	782·8403	6732	·3	791·4750	4372

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.	t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.
°			°		
11·4	791·7536	2·8985900	14·5	800·3883	2·9033007
11·5	792·0321	7428	·6	800·6668	4518
·6	792·3106	8955	·7	800·9454	6029
·7	792·5892	2·8990482	·8	801·2239	7539
·8	792·8677	2008	·9	801·5025	9049
·9	793·1463	3533	15·0	801·7810	2·9040558
12·0	793·4248	2·8995058	·1	802·0595	2066
·1	793·7033	6582	·2	802·3381	3574
·2	793·9819	8106	·3	802·6166	5081
·3	794·2604	9629	·4	802·8952	6588
·4	794·5390	2·9001152	15·5	803·1737	8095
12·5	794·8175	2674	·6	803·4522	9601
·6	795·0960	4196	·7	803·7308	2·9051106
·7	795·3746	5717	·8	804·0093	2611
·8	795·6531	7238	·9	804·2879	4115
·9	795·9317	8758	16·0	804·5664	2·9055619
13·0	796·2102	2·9010277	·1	804·8449	7122
·1	796·4887	1796	·2	805·1235	8625
·2	796·7673	3315	·3	805·4020	2·9060127
·3	797·0458	4833	·4	805·6806	1628
·4	797·3244	6350	16·5	805·9591	2·9063129
13·5	797·6029	7867	·6	806·2376	4630
·6	797·8814	9384	·7	806·5162	6130
·7	798·1600	2·9020900	·8	806·7947	7630
·8	798·4385	2415	·9	807·0733	9129
·9	798·7171	3930	17·0	807·3518	2·9070628
14·0	798·9956	2·9025444	·1	807·6303	2126
·1	799·2741	6957	·2	807·9089	3624
·2	799·5527	8470	·3	808·1874	5121
·3	799·8312	9983	·4	808·4660	6618
·4	800·1098	2·9031495	17·5	808·7445	8114

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.	t	$760 \times (1 + \delta t)$.	Log. $[760 \times (1 + \delta t)]$.
°			°		
17·6	809·0230	2·9079609	20·7	817·6578	2·9125716
·7	809·3016	2·9081104	·8	817·9363	7195
·8	809·5801	2598	·9	818·2149	8674
·9	809·8587	4092	21·0	818·4934	2·9130152
18·0	810·1372	2·9085586	·1	818·7719	1630
·1	810·4175	7079	·2	819·0505	3107
·2	810·6943	8571	·3	819·3290	4583
·3	810·9728	2·9090063	·4	819·6076	6059
·4	811·2514	1554	21·5	819·8861	7535
18·5	811·5299	3045	·6	820·1646	9010
·6	811·8084	4535	·7	820·4432	2·9140485
·7	812·0870	6025	·8	820·7217	1960
·8	812·3655	7515	·9	821·0003	3434
·9	812·6441	9004	22·0	821·2788	2·9144907
19·0	812·9226	2·9100492	·1	821·5573	6380
·1	813·2011	1980	·2	821·8859	7852
·2	813·4797	3467	·3	822·1144	9323
·3	813·7582	4954	·4	822·3930	2·9150794
·4	814·0368	6440	22·5	822·6715	2265
19·5	814·3153	7926	·6	822·9500	3735
·6	814·5938	9411	·7	823·2286	5205
·7	814·8724	2·9110896	·8	823·5071	6674
·8	815·1500	2380	·9	823·7857	8143
·9	815·4925	3864	23·0	824·0642	2·9159611
20·0	815·7080	2·9115347	·1	824·3427	2·9161079
·1	815·9865	6830	·2	824·6213	2546
·2	816·2651	8312	·3	824·8998	4013
·3	816·5436	9794	·4	825·1784	5479
·4	816·8222	2·9121275	23·5	825·4569	6945
20·5	817·1007	2756	·6	825·7354	8410
·6	817·3792	4236	·7	826·0140	9875

TABLE FOR CORRECTION OF VOLUMES OF GASES—*continued.*

t	760 × $(1 + \delta t)$.	Log. [760 × $(1 + \delta t)$].
°		
23·8	826·2925	2·9171339
·9	826·5711	2802
24·0	826·8496	2·9174265
·1	827·1281	5728
·2	827·4067	7190
·3	827·6852	8652
·4	827·9638	2·9180114
24·5	828·2423	1575
·6	828·5208	3035
·7	828·7994	4495
·8	829·0779	5954
·9	829·3565	7412
25·0	829·6350	2·9188870
·1	829·9135	2·9190328
·2	830·1921	1785
·3	830·4706	3242
·4	830·7492	4699
25·5	831·0277	2·9196155
·6	831·3062	7610
·7	831·5848	9065
·8	831·8633	2·9200520
·9	832·1419	1974
26·0	832·4204	2·9203427
·1	832·6989	4880
·2	832·9775	6333
·3	833·2560	7785
·4	833·5346	9237
26·5	833·8131	2·9210688
·6	834·0916	2139
·7	834·3702	3589
·8	834·6487	5038
·9	834·9273	6487
°		
27·0	835·2058	2·9217936
·1	835·4843	9384
·2	835·7629	2·9220832
·3	836·0414	2279
·4	836·3200	3725
27·5	836·5985	5171
·6	836·8770	6617
·7	837·1556	8062
·8	837·4341	9507
·9	837·7127	2·9230951
28·0	837·9912	2·9232395
·1	838·2697	3838
·2	838·5483	5281
·3	838·8268	6723
·4	839·1054	8165
28·5	839·3839	2·9239606
·6	839·6624	2·9241047
·7	839·9410	2488
·8	840·2195	3928
·9	840·4981	5368
29·0	840·7766	2·9246807
·1	841·0551	8246
·2	841·3337	9684
·3	841·6122	2·9251122
·4	841·8908	2559
29·5	842·1693	3995
·6	842·4478	5431
·7	842·7264	6866
·8	843·0049	8301
·9	843·2835	9736
30·0	843·5620	2·9261171

TABLE OF THE VALUES OF $\frac{B}{760}$.

B	$\frac{B}{760}$	Log. $\frac{B}{760}$	B	$\frac{B}{760}$	Log. $\frac{B}{760}$
mm.			mm.		
1	0·0013	$\bar{3}$·11394	300	0·3948	$\bar{1}$·59638
10	0132	$\bar{2}$·12057	310	4079	61055
20	0263	41996	320	4211	62439
30	0395	59660	330	4342	63769
40	0526	72099	340	4474	65070
50	0658	81823	350	4605	66323
60	0790	89763	360	4737	67550
70	0921	96426	370	4868	68735
80	1053	$\bar{1}$·02243	380	5000	69897
90	1184	07335	390	5132	71029
100	1316	11926	400	5263	72123
110	1447	16047	410	5395	73199
120	1579	19838	420	5526	74241
130	1710	23300	430	5658	75266
140	1842	26529	440	5790	76268
150	1974	29535	450	5921	77240
160	2092	32056	460	6053	78197
170	2237	34967	470	6184	79127
180	2369	37457	480	6316	80044
190	2500	39794	490	6447	80936
200	2631	42012	500	6579	81816
210	2763	44138	510	6711	82679
220	2895	46165	520	6842	83518
230	3026	48087	530	6974	84348
240	3158	49941	540	7106	85163
250	3290	51720	550	7237	85956
260	3421	53415	560	7369	86741
270	3553	55060	570	7500	87506
280	3684	56632	580	7632	88264
290	3816	58161	590	7763	89003

TABLE OF THE VALUES OF $\frac{B}{760}$—*continued.*

B	$\frac{B}{760}$	Log. $\frac{B}{760}$	B	$\frac{B}{760}$	Log. $\frac{B}{760}$
mm.			mm.		
600	0·7895	$\bar{1}$·89735	720	9474	$\bar{1}$·97653
610	8026	90450	721	9487	97713
620	8158	91158	722	9500	97772
630	8289	91850	723	9513	97832
640	8421	92536	724	9526	97891
650	8553	93212	725	9539	97950
660	8684	93872	726	9552	98009
670	8816	94527	727	9566	98073
680	8947	95168	728	9579	98132
690	9079	95804	729	9592	98191
700	9211	96431	730	9605	98250
701	9224	96492	731	9618	98309
702	9237	96553	732	9632	98372
703	9250	96614	733	9645	98430
704	9263	96675	734	9658	98489
705	9276	96736	735	9671	98547
706	9289	96797	736	9684	98606
707	9303	96862	737	9698	98668
708	9316	96923	738	9711	98726
709	9329	96984	739	9724	98785
710	9342	97044	740	9737	98843
711	9355	97104	741	9750	98901
712	9368	97165	742	9763	98958
713	9382	97230	743	9776	99016
714	9395	97290	744	9790	99078
715	9408	97350	745	9803	99136
716	9421	97410	746	9816	99194
717	9434	97470	747	9829	99251
718	9448	97534	748	9842	99308
719	9461	97594	749	9855	99366

TABLE OF THE VALUES OF $\frac{B}{760}$—*continued.*

B	$\frac{B}{760}$	Log. $\frac{B}{760}$	B	$\frac{B}{760}$	Log. $\frac{B}{760}$
mm.			mm.		
750	0·9869	$\bar{1}$·99427	778	1·0237	0·01017
751	9882	99485	779	0250	01072
752	9895	99542	780	0263	01127
753	9908	99599	781	0276	01182
754	9921	99656	782	0290	01242
755	9934	99712	783	0303	01296
756	9947	99769	784	0316	01351
757	9961	99830	785	0329	01406
758	9974	99887	786	0342	01461
759	9987	99944	787	0355	01515
760	1·0000	0·00000	788	0368	01570
761	0013	00056	789	0382	01628
762	0026	00113	790	0395	01682
763	0039	00169	791	0408	01737
764	0053	00230	792	0421	01791
765	0066	00286	793	0434	01845
766	0079	00342	794	0447	01899
767	0092	00398	795	0461	01957
768	0105	00454	796	0474	02011
769	0118	00510	797	0487	02065
770	0132	00570	798	0500	02119
771	0145	00625	799	0513	02173
772	0158	00681	800	0526	02226
773	0171	00736	810	0658	02768
774	0184	00792	820	0790	03302
775	0197	00847	830	0921	03826
776	0211	00907	840	1053	04348
777	0224	00962			

TABLE OF THE VALUES OF log. $\frac{\cdot 0012934}{760\,(1+\delta t)} = \log a$

$\delta = \cdot 00367.$

t	Log. a	t	Log. a	t	Log. a	t	Log. a
−5	$\bar{4}$·23889	33	$\bar{4}$·181203	71	$\bar{4}$·130285	109	$\bar{4}$·084714
−4	23727	34	179784	72	129022	110	083577
−3	23566	35	178369	73	127763	111	082443
−2	23405	36	176959	74	126508	112	081312
−1	23245	37	175554	75	125256	113	080184
0	230852	38	174153	76	124008	114	079059
+1	229261	39	172756	77	122764	115	077937
2	227666	40	171364	78	121523	116	076817
3	226069	41	169976	79	120286	117	075701
4	224523	42	168593	80	119052	118	074587
5	222955	43	167214	81	117821	119	073476
6	221392	44	165840	82	116594	120	072369
7	219835	45	164470	83	115371	121	071263
8	218284	46	163104	84	114151	122	070161
9	216739	47	161742	85	112934	123	069062
10	215199	48	160385	86	111721	124	067965
11	213664	49	159032	87	110511	125	066871
12	212135	50	157683	88	109305	126	065780
13	210611	51	156339	89	108102	127	064691
14	209092	52	154998	90	106902	128	063605
15	207579	53	153664	91	105706	129	062522
16	206071	54	152336	92	104512	130	061442
17	204568	55	151001	93	103323	131	060364
18	203070	56	149677	94	102136	132	059289
19	201577	57	148357	95	100952	133	058217
20	200090	58	147041	96	099772	134	057147
21	198608	59	145729	97	098595	135	056080
22	197130	60	144421	98	097431	136	055015
23	195658	61	143116	99	096251	137	053953
24	194191	62	141816	100	095083	138	052894
25	192728	63	140520	101	093919	139	051837
26	191271	64	139227	102	092758	140	050783
27	189818	65	137938	103	092599	141	049732
28	188371	66	136653	104	090144	142	048682
29	186928	67	135372	105	089292	143	047636
30	185490	68	134095	106	088143	144	046592
31	184056	69	132821	107	086997	145	045550
32	182927	70	131551	108	085854	146	044511

TABLE OF THE VALUES of log. $\frac{\cdot 0012934}{760\,(1 + \delta t)}$ —*continued.*

t	Log. *a*	*t*	Log. *a*	*t*	Log. *a*	*t*	Log. *a*
147	$\bar{4}$ 043475	186	$\bar{4}$·004866	225	$\bar{3}$·969410	263	$\bar{3}$·937443
148	042441	187	003919	226	968538	264	936632
149	041409	188	002975	227	967668	265	935824
150	040380	189	002033	228	966799	266	935016
151	039358	190	001093	229	965932	267	934211
152	038329	191	000155	230	965067	268	933406
153	037307	192	$\bar{3}$·999219	231	964204	269	932604
154	036287	193	998285	232	963342	270	931702
155	035270	194	997353	233	962482	271	931002
·156	034255	195	996423	234	961624	272	930204
157	033243	196	995495	235	960767	273	929407
158	032233	197	994569	236	959912	274	928612
159	031225	198	993645	237	959059	275	927818
160	030220	199	992723	238	958207	276	927025
161	029217	200	991803	239	957357	277	926231
162	028216	201	990884	240	956509	278	925444
163	027218	202	989968	241	955662	279	924656
164	026222	203	989054	242	954817	280	923869
165	025228	204	988141	243	953974	281	923084
166	024236	205	987231	244	953132	282	922300
167	023247	206	986322	245	952292	283	921518
168	022260	207	985416	246	951454	284	920736
169	021275	208	984511	247	950617	285	919957
170	020292	209	983608	248	949782	286	919178
171	019312	210	982707	249	948948	287	918401
172	018334	211	981807	250	948116	288	917626
173	017358	212	980910	251	947286	289	916852
174	016384	213	980015	252	946457	290	916079
175	015412	214	979121	253	945630	291	915307
·176	014444	215	978229	254	944804	292	914537
177	013476	216	977339	255	943980	293	913769
178	012510	217	976451	256	943157	294	913001
179	011547	218	975565	257	942336	295	912235
180	010587	219	974680	258	941517	296	911471
181	009628	220	973797	259	940699	297	910707
182	008671	221	972916	260	939883	298	909945
183	007717	222	972037	261	939068	299	909185
184	006764	223	971160	262	938254	300	908426
185	005814	224	970284				

TABLE FOR THE CALCULATION OF $\left(\frac{1}{1 + 00367\,T}\right)$.

T.		T.		T.		T.		T.	
1	·99634	31	·89785	61	·81708	91	·74964	121	·69249
2	·99271	32	·89490	62	·81464	92	·74758	122	·69073
3	·98911	33	·89197	63	·81221	93	·74554	123	·68899
4	·98553	34	·88906	64	·80979	94	·74351	124	·68725
5	·98198	35	·88617	65	·80740	95	·74148	125	·68552
6	·97845	36	·88330	66	·80501	96	·73947	126	·68380
7	·97495	37	·88044	67	·80264	97	·73747	127	·68209
8	·97148	38	·87761	68	·80028	98	·73548	128	·68038
9	·96803	39	·87479	69	·79794	99	·73350	129	·67869
10	·96460	40	·87199	70	·79561	100	·73153	130	·67700
11	·96120	41	·86921	71	·79329	101	·72957	131	·67532
12	·95782	42	·86645	72	·79099	102	·72762	132	·67365
13	·95446	43	·86370	73	·78870	103	·72568	133	·67199
14	·95113	44	·86097	74	·78642	104	·72376	134	·67034
15	·94782	45	·85826	75	·78416	105	·72184	135	·66870
16	·94454	46	·85556	76	·78191	106	·71993	136	·66706
17	·94127	47	·85289	77	·77967	107	·71803	137	·66543
18	·93803	48	·85022	78	·77745	108	·71615	138	·66380
19	·93482	49	·84758	79	·77523	109	·71427	139	·66219
20	·93162	50	·84495	80	·77304	110	·71240	140	·66059
21	·92844	51	·84234	81	·77085	111	·71055	141	·65899
22	·92529	52	·83974	82	·76867	112	·70870	142	·65740
23	·92216	53	·83716	83	·76651	113	·70686	143	·65582
24	·91905	54	·83460	84	·76436	114	·70503	144	·65424
25	·91596	55	·83205	85	·76222	115	·70321	145	·65268
26	·91289	56	·82952	86	·76010	116	·70140	146	·65112
27	·90984	57	·82700	87	·75798	117	·69960	147	·64957
28	·90682	58	·82450	88	·75588	118	·69781	148	·64802
29	·90381	59	·82201	89	·75379	119	·69603	149	·64648
30	·90082	60	·81954	90	·75171	120	·69425	150	·64495

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE AND PRESSURE (LUNGE).

I. Table for reducing the volumes of gases to a temperature of 0° C.

C^2 at 0° C.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
1	0·996	0·993	0·989	0·986	0·982	0·978	0·975	0·972	0·968	0·965
2	1·993	1·985	1·978	1·971	1·964	1·957	1·950	1·943	1·936	1·929
3	2·989	2·978	2·967	2·957	2·946	2·936	2·925	2·915	2·904	2·894
4	3·985	3·971	3·956	3·942	3·928	3·914	3·900	3·886	3·872	3·859
5	4·982	4·964	4·946	4·928	4·910	4·893	4·875	4·858	4·841	4·824
6	5·978	5·956	5·935	5·913	5·892	5·871	5·850	5·830	5·809	5·788
7	6·974	6·949	6·924	6·899	6·874	6·850	6·825	6·801	6·777	6·753
8	7·970	7·942	7·913	7·885	7·856	7·828	7·800	7·773	7·745	7·718
9	8·967	8·934	8·902	8·870	8·838	8·807	8·775	8·744	8·713	8·692
10	9·963	9·927	9·891	9·856	9·820	9·785	9·750	9·716	9·681	9·647
11	10·96	10·92	10·88	10·84	10·80	10·76	10·73	10·69	10·65	10·61
12	11·96	11·91	11·87	11·83	11·78	11·74	11·70	11·66	11·62	11·57
13	12·95	12·91	12·86	12·81	12·76	12·72	12·68	12·63	12·59	12·54
14	13·95	13·90	13·85	13·80	13·75	13·70	13·65	13·60	13·55	13·50
15	14·95	14·89	14·84	14·78	14·73	14·68	14·63	14·57	14·52	14·47
16	15·94	15·88	15·83	15·77	15·71	15·66	15·60	15·55	15·49	15·43
17	16·94	16·87	16·82	16·75	16·69	16·64	16·58	16·52	16·46	16·40
18	17·93	17·87	17·81	17·74	17·67	17·61	17·55	17·49	17·43	17·36
19	18·93	18·86	18·79	18·72	18·65	18·59	18·53	18·46	18·39	18·33
20	19·93	19·85	19·78	19·71	19·64	19·57	19·50	19·43	19·36	19·29
21	20·93	20·84	20·77	20·69	20·62	20·55	20·48	20·40	20·33	20·26
22	21·92	21·84	21·76	21·68	21·60	21·53	21·45	21·37	21·30	21·22
23	22·92	22·83	22·75	22·66	22·58	22·51	22·43	22·35	22·26	22·18
24	23·92	23·82	23·74	23·65	23·56	23·48	23·40	23·32	23·23	23·15
25	24·91	24·81	24·73	24·64	24·55	24·46	24·38	24·29	24·20	24·11

Table for Reduction of Volume of Gases to Normal Temperature, Etc.—*continued*.

C^2 at 0° C.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
26	25·91	25·81	25·72	25·62	25·53	25·44	25·35	25·26	25·17	25·08
27	26·90	26·80	26·71	26·61	26·52	26·42	26·33	26·23	26·13	26·04
28	27·90	27·79	27·69	27·59	27·50	27·40	27·30	27·20	27·10	27·01
29	28·90	28·78	28·68	28·58	28·48	28·38	28·28	28·17	28·07	27·97
30	29·89	29·78	29·67	29·57	29·46	29·36	29·25	29·15	29·04	28·94
31	30·89	30·77	30·66	30·55	30·44	30·34	30·23	30·12	30·01	29·91
32	31·88	31·76	31·65	31·54	31·42	31·32	31·20	31·09	30·98	30·87
33	32·88	32·76	32·64	32·52	32·40	32·30	32·18	32·06	31·94	31·84
34	33·88	33·75	33·63	33·51	33·38	33·27	33·15	33·03	32·91	32·80
35	34·87	34·74	34·62	34·50	34·37	34·25	34·13	34·01	33·88	33·77
36	35·87	35·74	35·61	35·48	35·35	35·23	35·10	34·98	34·85	34·73
37	36·87	36·73	36·60	36·47	36·33	36·21	36·08	35·95	35·82	35·70
38	37·86	37·72	37·59	37·45	37·32	37·19	37·05	36·92	36·79	36·66
39	38·86	38·71	38·58	38·44	38·30	38·16	38·03	37·89	37·75	37·62
40	39·85	39·71	39·56	39·42	39·28	39·14	39·00	38·86	38·72	38·59
41	40·85	40·70	40·55	40·41	40·26	40·12	39·98	39·83	39·69	39·55
42	41·85	41·69	41·54	41·39	41·24	41·10	40·95	40·80	40·66	40·52
43	42·84	42·68	42·53	42·38	42·22	42·08	41·93	41·78	41·62	41·48
44	43·84	43·68	43·52	43·37	43·20	43·05	42·90	42·75	42·59	42·45
45	44·84	44·67	44·51	44·35	44·19	44·03	43·88	43·72	43·56	43·41
46	45·83	45·66	45·50	45·34	45·17	45·01	44·85	44·69	44·53	44·38
47	46·83	46·65	46·48	46·32	46·15	45·99	45·83	45·66	45·50	45·34
48	47·83	47·65	47·48	47·31	47·13	46·97	46·80	46·63	46·47	46·31
49	48·82	48·64	48·47	48·29	48·12	47·95	47·78	47·60	47·44	47·27
50	49·82	49·64	49·46	49·28	49·10	48·93	48·75	48·58	48·41	48·24

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
51	50·82	50·63	50·45	50·26	50·08	49·91	49·73	49·55	49·38	49·21
52	51·81	51·62	51·44	51·25	51·06	50·89	50·70	50·52	50·35	50·17
53	52·81	52·62	52·43	52·24	52·05	51·87	51·68	51·49	51·31	51·13
54	53·81	53·61	53·42	53·22	53·03	52·84	52·65	52·46	52·28	52·10
55	54·80	54·60	54·41	54·21	54·01	53·82	53·63	53·44	53·25	53·06
56	55·80	55·60	55·40	55·19	54·99	54·80	54·60	54·41	54·22	54·03
57	56·80	56·59	56·39	56·18	55·97	55·78	55·58	55·38	55·19	54·99
58	57·79	57·58	57·37	57·16	56·95	56·76	56·55	56·35	56·15	55·96
59	58·79	58·57	58·37	58·15	57·93	57·74	57·53	57·32	57·12	56·92
60	59·78	59·56	59·35	59·13	58·92	58·71	58·50	58·30	58·09	57·88
61	60·78	60·56	60·34	60·12	59·90	59·69	59·48	59·27	59·06	58·85
62	61·78	61·55	61·33	61·10	60·88	60·67	60·45	60·24	60·03	59·81
63	62·77	62·54	62·32	62·09	61·86	61·65	61·43	61·21	60·99	60·77
64	63·77	63·53	63·31	63·07	62·84	62·63	62·40	62·18	61·96	61·74
65	64·76	64·53	64·30	64·06	63·83	63·61	63·38	63·15	62·93	62·70
66	65·76	65·52	65·29	65·04	64·81	64·58	64·35	64·13	63·89	63·67
67	66·75	66·51	66·27	66·03	65·79	65·56	65·33	65·10	64·86	64·63
68	67·75	67·50	67·26	67·02	66·77	66·54	66·30	66·07	65·83	65·60
69	68·75	68·50	68·25	68·01	67·75	67·52	67·28	67·04	66·80	66·56
70	69·74	69·49	69·24	68·99	68·74	68·50	68·25	68·01	67·77	67·53
71	70·74	70·48	70·23	69·98	69·72	69·48	69·23	68·98	68·74	68·49
72	71·74	71·48	71·22	70·96	70·70	70·46	70·20	69·95	69·71	69·46
73	72·73	72·47	72·21	71·95	71·69	71·44	71·18	70·93	70·67	70·42
74	73·73	73·46	73·20	72·93	72·66	72·41	72·15	71·90	71·64	71·39
75	74·72	74·45	74·19	73·92	73·65	73·39	73·13	72·87	72·61	72·35

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
76	75·72	75·45	75·18	74·90	74·63	74·37	74·10	73·84	73·58	73·32
77	76·72	76·44	76·17	75·89	75·61	75·35	75·08	74·81	74·55	74·28
78	77·71	77·43	77·15	76·87	76·59	76·33	76·05	75·78	75·51	75·25
79	78·71	78·42	78·14	77·86	77·58	77·31	77·03	76·75	76·48	76·21
80	79·70	79·42	79·13	78·85	78·56	78·28	78·00	77·73	77·45	77·18
81	80·70	80·41	80·12	79·83	79·54	79·26	78·98	78·70	78·42	78·14
82	81·69	81·40	81·11	80·82	80·52	80·24	79·95	79·67	79·39	79·11
83	82·69	82·39	82·10	81·81	81·51	81·22	80·93	80·64	80·36	80·07
84	83·69	83·39	83·09	82·79	82·49	82·20	81·90	81·61	81·32	81·04
85	84·68	84·38	84·08	83·78	83·47	83·17	82·88	82·58	82·29	82·00
86	85·68	85·37	85·07	84·76	84·45	84·15	83·85	83·55	83·26	82·97
87	86·68	86·37	86·06	85·75	85·43	85·13	84·83	84·53	84·23	83·93
88	87·67	87·36	87·05	86·73	86·42	86·11	85·80	85·50	85·20	84·90
89	88·67	88·35	88·04	87·72	87·40	87·09	86·78	86·47	86·16	85·86
90	89·67	89·34	89·02	88·70	88·38	88·07	87·75	87·44	87·13	86·82
91	90·66	90·34	90·01	89·69	89·36	89·05	88·73	88·41	88·10	87·79
92	91·66	91·33	91·00	90·67	90·34	90·03	89·70	89·38	89·07	88·75
93	92·66	92·32	91·99	91·66	91·33	91·01	90·68	90·36	90·03	89·72
94	93·65	93·31	92·98	92·64	92·31	91·98	91·65	91·33	91·00	90·68
95	94·65	94·31	93·97	93·63	93·29	92·96	92·63	92·30	91·97	91·65
96	95·65	95·30	94·96	94·61	94·27	93·94	93·60	93·27	92·94	92·61
97	96·64	96·29	95·95	95·60	95·25	94·92	94·58	94·24	93·91	93·57
98	97·64	97·28	96·93	96·58	96·24	95·90	95·55	95·21	94·87	94·54
99	98·64	98·27	97·92	97·57	97·22	96·87	96·53	96·18	95·84	95·50
100	99·63	99·27	98·91	98·56	98·20	97·85	97·50	97·16	96·81	96·47

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
1	0·961	0·958	0·955	0·951	0·948	0·945	0·941	0·938	0·935	0·932
2	1·923	1·916	1·909	1·903	1·896	1·889	1·883	1·876	1·869	1·864
3	2·884	2·874	2·864	2·854	2·844	2·834	2·824	2·815	2·805	2·795
4	3·845	3·832	3·818	3·805	3·792	3·779	3·766	3·753	3·740	3·727
5	4·807	4·790	4·773	4·757	4·740	4·724	4·707	4·691	4·675	4·659
6	5·768	5·747	5·728	5·708	5·688	5·668	5·648	5·629	5·609	5·591
7	6·729	6·705	6·682	6·659	6·636	6·613	6·590	6·567	6·544	6·523
8	7·690	7·663	7·637	7·610	7·584	7·558	7·531	7·506	7·479	7·454
9	8·652	8·621	8·591	8·562	8·532	8·502	8·472	8·444	8·414	8·386
10	9·613	9·579	9·546	9·513	9·480	9·447	9·414	9·382	9·349	9·318
11	10·57	10·53	10·50	10·46	10·43	10·39	10·35	10·32	10·28	10·25
12	11·53	11·49	11·45	11·42	11·38	11·33	11·30	11·26	11·21	11·18
13	12·49	12·45	12·41	12·36	12·32	12·28	12·24	12·20	12·15	12·11
14	13·45	13·41	13·36	13·31	13·27	13·22	13·17	13·13	13·08	13·04
15	14·42	14·37	14·32	14·27	14·22	14·17	14·12	14·07	14·02	13·97
16	15·38	15·32	15·27	15·22	15·17	15·11	15·06	15·01	14·96	14·91
17	16·34	16·28	16·23	16·17	16·12	16·06	16·00	15·95	15·89	15·84
18	17·30	17·24	17·18	17·12	17·06	17·00	16·94	16·89	16·82	16·76
19	18·26	18·20	18·14	18·07	18·01	17·95	17·89	17·83	17·76	17·70
20	19·23	19·16	19·09	19·03	18·96	18·89	18·83	18·76	18·69	18·64
21	20·19	20·12	20·04	19·98	19·91	19·84	19·77	19·70	19·62	19·57
22	21·15	21·08	21·00	20·93	20·86	20·78	20·71	20·64	20·56	20·50
23	22·11	22·03	21·95	21·88	21·80	21·73	21·65	21·58	21·50	21·43
24	23·07	22·99	22·91	22·83	22·75	22·67	22·59	22·51	22·43	22·37
25	24·03	23·95	23·86	23·78	23·70	23·61	23·54	23·45	23·37	23·30

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
26	25·00	24·91	24·81	24·73	24·65	24·56	24·48	24·39	24·30	24·23
27	25·96	25·87	25·77	25·69	25·60	25·50	25·42	25·33	25·23	25·16
28	26·92	26·82	26·72	26·64	26·54	26·45	26·36	26·27	26·17	26·09
29	27·88	27·78	27·68	27·59	27·49	27·39	27·30	27·20	27·10	27·02
30	28·84	28·74	28·64	28·54	28·44	28·34	28·24	28·15	28·05	27·95
31	29·80	29·70	29·59	29·49	29·39	29·28	29·18	29·09	28·99	28·87
32	30·76	30·66	30·55	30·44	30·34	30·23	30·12	30·03	29·92	29·81
33	31·72	31·61	31·50	31·39	31·28	31·17	31·06	30·97	30·86	30·74
34	32·68	32·57	32·46	32·34	32·23	32·12	32·01	31·90	31·79	31·68
35	33·65	33·53	33·41	33·30	33·18	33·06	32·95	32·84	32·73	32·61
36	34·61	34·49	34·37	34·25	34·13	34·01	33·89	33·78	33·66	33·54
37	35·57	35·45	35·32	35·20	35·08	34·95	34·83	34·72	34·59	34·47
38	36·53	36·40	36·28	36·15	36·02	35·90	35·77	35·66	35·53	35·40
39	37·49	37·36	37·23	37·10	36·97	36·84	36·71	36·59	36·46	36·34
40	38·45	38·32	38·18	38·05	37·92	37·79	37·66	37·53	37·40	37·27
41	39·41	39·28	39·14	39·00	38·87	38·73	38·60	38·47	38·34	38·20
42	40·37	40·24	40·09	39·95	39·82	39·68	39·54	39·41	39·27	39·13
43	41·33	41·19	41·05	40·90	40·76	40·62	40·48	40·35	40·21	40·07
44	42·30	42·15	42·00	41·86	41·71	41·57	41·43	41·28	41·14	41·00
45	43·26	43·11	42·95	42·81	42·66	42·51	42·37	42·22	42·08	41·93
46	44·29	44·07	43·91	43·76	43·61	43·46	43·31	43·16	43·01	42·86
47	45·18	45·03	44·86	44·71	44·56	44·40	44·25	44·10	43·94	43·79
48	46·14	45·98	45·82	45·66	45·50	45·35	45·19	45·04	44·88	44·72
49	47·10	46·94	46·77	46·61	46·45	46·29	46·13	45·97	45·81	45·65
50	48·07	47·90	47·73	47·57	47·40	47·24	47·07	46·91	46·75	46·59

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
51	49·03	48·86	48·69	48·52	48·35	48·18	48·01	47·85	47·68	47·52
52	49·99	49·82	49·64	49·47	49·30	49·13	48·95	48·79	48·62	48·45
53	50·95	50·77	50·59	50·42	50·24	50·07	49·89	49·72	49·55	49·38
54	51·91	51·73	51·55	51·37	51·19	51·02	50·54	50·66	50·49	50·32
55	52·87	52·69	52·50	52·33	52·14	51·96	51·78	51·60	51·43	51·25
56	53·84	53·65	53·46	53·28	53·09	52·91	52·72	52·54	52·36	52·18
57	54·80	54·61	54·41	54·23	54·04	53·86	53·66	53·48	53·29	53·11
58	55·76	55·56	55·37	55·18	54·98	54·80	54·60	54·42	54·23	54·04
59	56·72	56·52	56·32	56·13	55·93	55·74	55·54	55·35	55·16	54·97
60	57·68	57·47	57·28	57·08	56·88	56·68	56·48	56·29	56·09	55·91
61	58·64	58·43	58·23	58·03	57·83	57·63	57·42	57·23	57·02	56·84
62	59·60	59·39	59·19	58·98	58·78	58·57	58·36	58·17	57·96	57·77
63	60·56	60·35	60·14	59·93	59·72	59·52	59·30	59·11	58·90	58·71
64	61·53	61·31	61·10	60·88	60·67	60·46	60·25	60·04	59·83	59·64
65	62·49	62·26	62·05	61·84	61·62	61·40	61·19	60·98	60·77	60·57
66	63·45	63·22	63·01	62·79	62·57	62·35	62·13	61·92	61·70	61·50
67	64·41	64·18	63·96	63·74	63·52	63·29	63·07	62·86	62·63	62·43
68	65·37	65·13	64·92	64·69	64·46	64·23	64·01	63·80	63·57	63·36
69	66·33	66·09	65·87	65·64	65·41	65·18	64·95	64·73	64·50	64·30
70	67·29	67·05	66·82	66·59	66·36	66·13	65·90	65·67	65·44	65·23
71	68·25	68·01	67·77	67·54	67·31	67·07	66·84	66·61	66·38	66·16
72	69·21	68·97	68·73	68·49	68·26	68·02	67·78	67·55	67·31	67·09
73	70·17	69·92	69·68	69·44	69·20	68·96	68·72	68·49	68·26	68·03
74	71·14	70·88	70·64	70·40	70·15	69·91	69·66	69·42	69·18	68·96
75	72·10	71·84	71·59	71·35	71·10	70·85	70·61	70·37	70·12	69·89

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
76	73·06	72·80	72·55	72·30	72·05	71·80	71·55	71·30	71·05	70·82
77	74·02	73·76	73·51	73·25	73·00	72·74	72·49	72·24	71·98	71·75
78	74·98	74·71	74·46	74·20	73·94	73·69	73·43	73·18	72·92	72·68
79	75·94	75·67	75·41	75·15	74·89	74·63	74·37	74·11	73·85	73·61
80	76·90	76·63	76·37	76·10	75·84	75·58	75·31	75·06	74·79	74·54
81	77·86	77·59	77·32	77·05	76·79	76·52	76·25	76·00	75·73	75·47
82	78·82	78·55	78·28	78·00	77·74	77·47	77·19	76·94	76·66	76·40
83	79·78	79·50	79·23	78·95	78·68	78·41	78·13	77·87	77·60	77·34
84	80·75	80·46	80·19	79·91	79·63	79·35	79·08	78·81	78·53	78·27
85	81·71	81·42	81·14	80·86	80·58	80·30	80·02	79·75	79·47	79·20
86	82·67	82·38	82·10	81·81	81·53	81·24	80·96	80·69	80·40	80·13
87	83·63	83·33	83·05	82·76	82·48	82·19	81·90	81·63	81·33	81·06
88	84·59	84·29	84·01	83·71	83·42	83·13	82·84	82·57	82·27	81·99
89	85·56	85·25	84·96	84·66	84·37	84·08	83·78	83·50	83·22	82·93
90	86·52	86·21	85·92	85·62	85·32	85·02	84·72	84·44	84·14	83·86
91	87·48	87·17	86·87	86·57	86·27	85·96	85·66	85·38	85·07	84·79
92	88·44	88·13	87·83	87·52	87·22	86·91	86·60	86·32	86·01	85·72
93	89·40	89·08	88·78	88·47	88·16	87·85	87·54	87·25	86·95	86·66
94	90·36	90·04	89·73	89·42	89·11	88·80	88·49	88·19	87·88	87·59
95	91·33	91·00	90·68	90·38	90·06	89·74	89·43	89·13	88·82	88·52
96	92·29	91·96	91·64	91·33	91·01	90·69	90·37	90·07	89·75	89·45
97	93·25	92·92	92·59	92·28	91·96	91·63	91·31	91·00	90·68	90·38
98	94·21	93·87	93·55	93·23	92·90	92·58	92·25	91·94	91·62	91·31
99	95·17	94·83	94·50	94·18	93·85	93·52	93·19	92·88	92·55	92·24
100	96·13	95·79	95·46	95·13	94·80	94·47	94·14	93·82	93·49	93·18

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	21°	22°	23°	24°	25°	26°	27°	28°	29°
1	0·929	0·926	0·922	0·919	0·916	0·913	0·910	0·907	0·904
2	1·857	1·851	1·845	1·839	1·832	1·826	1·820	1·814	1·808
3	2·786	2·777	2·767	2·758	2·749	2·739	2·730	2·721	2·712
4	3·714	3·702	3·690	3·677	3·665	3·652	3·640	3·628	3·616
5	4·643	4·628	4·612	4·597	4·581	4·566	4·551	4·535	4·520
6	5·572	5·553	5·534	5·516	5·497	5·479	5·461	5·442	5·424
7	6·500	6·479	6·457	6·435	6·413	6·392	6·371	6·349	6·328
8	7·429	7·407	7·379	7·354	7·330	7·305	7·281	7·256	7·232
9	8·357	8·330	8·302	8·274	8·246	8·218	8·191	8·163	8·136
10	9·286	9·255	9·224	9·193	9·162	9·131	9·101	9·070	9·010
11	10·21	10·18	10·15	10·11	10·07	10·04	10·01	9·98	9·94
12	11·14	11·11	11·07	11·03	10·99	10·96	10·92	10·88	10·85
13	12·07	12·03	11·99	11·95	11·91	11·87	11·83	11·79	11·75
14	13·00	12·96	12·91	12·87	12·83	12·78	12·74	12·70	12·66
15	13·93	13·88	13·84	13·79	13·74	13·70	13·65	13·61	13·56
16	14·86	14·81	14·76	14·71	14·66	14·61	14·56	14·51	14·46
17	15·79	15·73	15·68	15·63	15·58	15·52	15·47	15·42	15·37
18	16·71	16·66	16·60	16·55	16·49	16·44	16·38	16·33	16·27
19	17·64	17·58	17·53	17·47	17·41	17·35	17·29	17·23	17·18
20	18·57	18·51	18·45	18·39	18·32	18·26	18·20	18·14	18·08
21	19·50	19·43	19·37	19·31	19·24	19·17	19·11	19·05	18·98
22	20·43	20·36	20·29	20·23	20·15	20·09	20·02	19·95	19·89
23	21·36	21·29	21·21	21·15	21·07	21·00	20·93	20·86	20·79
24	22·28	22·21	22·14	22·07	21·99	21·91	21·84	21·77	21·70
25	23·21	23·14	23·06	22·99	22·90	22·83	22·75	22·68	22·60

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	21°	22°	23°	24°	25°	26°	27°	28°	29°
26	24·14	24·06	23·98	23·91	23·82	23·74	23·66	23·58	23·50
27	25·07	24·99	24·90	24·83	24·73	24·65	24·57	24·49	24·41
28	26·00	25·91	25·82	25·74	25·65	25·57	25·48	25·40	25·31
29	26·93	26·84	26·75	26·67	26·57	26·48	26·39	26·30	26·22
30	27·86	27·77	27·67	27·58	27·49	27·39	27·30	27·21	27·12
31	28·79	28·70	28·59	28·50	28·41	28·30	28·21	28·12	28·02
32	29·72	29·62	29·51	29·42	29·32	29·22	29·12	29·02	28·93
33	30·65	30·55	30·44	30·34	30·24	30·13	30·03	29·93	29·83
34	31·57	31·47	31·36	31·26	31·16	31·04	30·94	30·84	30·74
35	32·50	32·40	32·28	32·18	32·07	31·96	31·85	31·75	31·64
36	33·43	33·32	33·20	33·10	32·99	32·87	32·76	32·65	32·54
37	34·36	34·25	34·12	34·02	33·90	33·78	33·67	33·56	33·45
38	35·29	35·17	35·05	34·93	34·82	34·70	34·58	34·47	34·35
39	36·22	36·10	35·97	35·85	35·74	35·61	35·49	35·37	35·26
40	37·14	37·02	36·90	36·77	36·65	36·52	36·40	36·28	36·16
41	38·07	37·95	37·82	37·69	37·57	37·43	37·31	37·19	37·06
42	39·00	38·87	38·74	38·61	38·48	38·35	38·22	38·09	37·97
43	39·93	39·80	39·66	39·53	39·40	39·26	39·13	39·00	38·87
44	40·85	40·72	40·59	40·45	40·32	40·17	40·04	39·91	39·78
45	41·78	41·65	41·51	41·37	41·23	41·09	40·95	40·82	40·68
46	42·71	42·57	42·43	42·29	42·15	42·00	41·86	41·72	41·58
47	43·64	43·50	43·35	43·21	43·06	42·91	42·77	42·63	42·49
48	44·57	44·42	44·27	44·12	43·98	43·83	43·68	43·54	43·39
49	45·50	45·35	45·19	45·04	44·89	44·74	44·59	44·44	44·30
50	46·43	46·28	46·12	45·97	45·81	45·66	45·51	45·35	45·20

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	21°	22°	23°	24°	25°	26°	27°	28°	29°
51	47·36	47·20	47·04	46·89	46·73	46·57	46·42	46·26	46·10
52	48·29	48·13	47·96	47·81	47·64	47·49	47·33	47·16	47·01
53	49·22	49·06	48·89	48·73	48·56	48·40	48·24	48·07	47·91
54	50·14	49·98	49·81	49·65	49·48	49·31	49·15	48·98	48·72
55	51·07	50·91	50·73	50·57	50·39	50·23	50·06	49·89	49·72
56	52·00	51·83	51·65	51·49	51·31	51·14	50·97	50·79	50·62
57	52·93	52·76	52·58	52·41	52·22	52·05	51·88	51·70	51·53
58	53·86	53·68	53·50	53·32	53·14	52·97	52·79	52·61	52·43
59	54·79	54·61	54·42	54·24	54·06	53·88	53·70	53·51	53·34
60	55·72	55·53	55·34	55·16	54·97	54·79	54·61	54·42	54·24
61	56·65	56·46	56·26	56·08	55·89	55·70	55·52	55·33	55·14
62	57·58	57·38	57·19	57·00	56·80	56·62	56·43	56·23	56·05
63	58·51	58·31	58·11	57·92	57·72	57·53	57·34	57·14	56·95
64	59·42	59·23	59·03	58·84	58·64	58·44	58·25	58·05	57·86
65	60·36	60·16	59·95	59·76	59·55	59·36	59·16	58·96	58·76
66	61·29	61·08	60·87	60·68	60·47	60·27	60·07	59·86	59·66
67	62·22	62·01	61·79	61·60	61·38	61·18	60·98	60·77	60·57
68	63·15	62·93	62·72	62·51	62·30	62·10	61·89	61·68	61·47
69	64·08	63·86	63·64	63·43	63·22	63·01	62·80	62·58	62·38
70	65·00	64·79	64·57	64·35	64·13	63·92	63·71	63·49	63·28
71	65·93	65·71	65·49	65·27	65·05	64·83	64·62	64·40	64·18
72	66·86	66·64	66·42	66·19	65·96	65·75	65·53	65·30	65·09
73	67·79	67·57	67·34	67·11	66·88	66·66	66·44	66·21	65·99
74	68·61	68·49	68·26	68·03	67·80	67·57	67·35	67·12	66·90
75	69·64	69·42	69·18	68·95	68·71	68·49	68·26	68·03	67·80

TABLE FOR REDUCTION OF VOLUME OF GASES TO NORMAL TEMPERATURE, ETC.—*continued.*

C^2 at 0° C.	21°	22°	23°	24°	25°	26°	27°	28°	29°
76	70·57	70·34	70·10	69·87	69·63	69·40	69·17	68·93	68·70
77	71·50	71·27	71·03	70·79	70·54	70·31	70·08	69·84	69·61
78	72·43	72·19	71·95	71·70	71·46	71·22	70·99	70·75	70·51
79	73·36	73·12	72·87	72·62	72·38	72·14	71·90	71·65	71·42
80	74·29	74·04	73·79	73·54	73·30	73·05	72·81	72·56	72·32
81	75·22	74·97	74·71	74·46	74·22	73·96	73·72	73·47	73·22
82	76·15	75·89	75·63	75·38	75·13	74·88	74·63	74·37	74·13
83	77·08	76·82	76·56	76·30	76·05	75·79	75·54	75·28	75·03
84	78·00	77·74	77·48	77·22	76·96	76·70	76·45	76·19	75·94
85	78·93	78·67	78·40	78·14	77·88	77·62	77·36	77·10	76·84
86	79·86	79·59	79·32	79·06	78·80	78·53	78·27	78·00	77·74
87	80·79	80·52	80·25	79·98	79·71	79·44	79·18	78·91	78·65
88	81·72	81·44	81·17	80·90	80·63	80·36	80·09	79·82	79·55
89	82·65	82·37	82·09	81·82	81·55	81·27	81·00	80·72	80·46
90	83·57	83·30	83·02	82·74	82·46	82·18	81·91	81·63	81·36
91	84·50	84·22	83·94	83·66	83·38	83·09	82·82	82·54	82·26
92	85·43	85·15	84·86	84·58	84·29	84·01	83·73	83·44	83·17
93	86·36	86·08	85·79	85·50	85·21	84·92	84·64	84·35	84·07
94	87·28	87·00	86·71	86·42	86·13	85·83	85·55	85·26	84·98
95	88·21	87·93	87·63	87·34	87·04	86·75	86·46	86·17	85·88
96	89·14	88·85	88·55	88·26	87·96	87·66	87·37	87·07	86·78
97	90·07	89·78	89·48	89·18	88·87	88·57	88·28	87·98	87·69
98	91·00	90·70	90·40	90·09	89·79	89·48	89·19	88·89	88·59
99	91·93	91·63	91·32	91·01	90·71	90·40	90·10	89·79	89·50
100	92·86	92·55	92·24	91·93	91·62	91·31	91·01	90·70	90·40

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM. (LUNGE).

Deduct from the pressure read off at the barometer 1 mm. for temperatures between 0° and 12° C., 2 mm. between 13° and 19° C., and 3 mm. between 20° and 25° C.

760	710	712	714	716	718	720	722	724	726	728
1	0·934	0·937	0·940	0·942	0·945	0·947	0·950	0·953	0·955	0·958
2	1·868	1·874	1·879	1·884	1·890	1·895	1·900	1·905	1·911	1·916
3	2·803	2·810	2·818	2·826	2·834	2·842	2·850	2·858	2·866	2·874
4	3·738	3·747	3·758	3·768	3·779	3·789	3·800	3·810	3·821	3·832
5	4·672	4·685	4·697	4·711	4·724	4·736	4·750	4·763	4·777	4·790
6	5·607	5·621	5·637	5·653	5·669	5·684	5·700	5·716	5·732	5·747
7	6·540	6·558	6·577	6·595	6·614	6·631	6·650	6·668	6·687	6·705
8	7·474	7·494	7·516	7·537	7·558	7·578	7·600	7·621	7·642	7·663
9	8·409	8·431	8·456	8·479	8·503	8·526	8·550	8·573	8·598	8·621
10	9·34	9·37	9·40	9·42	9·45	9·47	9·50	9·53	9·55	9·58
11	10·28	10·31	10·34	10·36	10·39	10·42	10·45	10·48	10·51	10·54
12	11·21	11·24	11·27	11·30	11·34	11·37	11·40	11·43	11·46	11·50
13	12·14	12·18	12·21	12·24	12·28	12·31	12·35	12·38	12·41	12·45
14	13·08	13·12	13·16	13·19	13·23	13·26	13·30	13·34	13·37	13·41
15	14·02	14·06	14·10	14·13	14·17	14·21	14·25	14·29	14·33	14·37
16	14·95	14·99	15·03	15·07	15·11	15·15	15·20	15·24	15·28	15·33
17	15·88	15·93	15·98	16·02	16·06	16·10	16·15	16·19	16·23	16·28
18	16·82	16·87	16·92	16·96	17·01	17·05	17·10	17·15	17·19	17·24
19	17·76	17·81	17·86	17·90	17·95	18·00	18·05	18·10	18·15	18·21
20	18·68	18·74	18·79	18·84	18·90	18·95	19·00	19·05	19·11	19·16
21	19·62	19·68	19·73	19·78	19·84	19·90	19·95	20·00	20·06	20·12
22	20·55	20·61	20·67	20·72	20·78	20·84	20·90	20·96	21·01	21·07
23	21·49	21·55	21·61	21·66	21·73	21·79	21·85	21·91	21·97	22·03
24	22·43	22·49	22·55	22·61	22·68	22·74	22·80	22·86	22·92	22·99
25	23·35	23·42	23·49	23·55	23·62	23·69	23·75	23·81	23·88	23·95

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	710	712	714	716	718	720	722	724	726	728
26	24·29	24·36	24·43	24·50	24·57	24·64	24·70	24·77	24·83	24·90
27	25·23	25·30	25·37	25·44	25·51	25·58	25·65	25·72	25·79	25·86
28	26·16	26·23	26·30	26·37	26·45	26·53	26·60	26·67	26·74	26·82
29	27·10	27·17	27·24	27·31	27·40	27·48	27·55	27·62	27·70	27·78
30	28·03	28·10	28·18	28·26	28·34	28·42	28·50	28·58	28·66	28·74
31	28·97	29·04	29·12	29·20	29·29	29·37	29·45	29·53	29·62	29·70
32	29·90	29·98	30·06	30·14	30·23	30·32	30·40	30·48	30·57	30·66
33	30·83	30·91	31·00	31·08	31·17	31·26	31·35	31·43	31·52	31·61
34	31·77	31·85	31·94	32·03	32·12	32·21	32·30	32·39	32·48	32·57
35	32·71	32·79	32·88	32·97	33·07	33·16	33·25	33·34	33·44	33·53
36	33·64	33·73	33·82	33·91	34·01	34·10	34·20	34·29	34·39	34·49
37	34·57	34·66	34·76	34·86	34·96	35·05	35·15	35·25	35·35	35·45
38	35·50	35·60	35·70	35·80	35·90	36·00	36·10	36·20	36·30	36·40
39	36·44	36·54	36·64	36·74	36·85	36·95	37·05	37·15	37·26	37·37
40	37·38	37·48	37·58	37·68	37·79	37·89	38·00	38·10	38·21	38·32
41	38·31	38·41	38·52	38·62	38·74	38·84	38·95	39·05	39·17	39·28
42	39·23	39·35	39·46	39·57	39·69	39·79	39·90	40·01	40·12	40·23
43	40·18	40·29	40·40	40·51	40·62	40·73	40·85	40·96	41·08	41·19
44	41·11	41·22	41·34	41·44	41·56	41·68	41·80	41·91	42·03	42·16
45	42·05	42·16	42·28	42·39	42·52	42·63	42·75	42·87	42·99	43·11
46	42·98	43·10	43·22	43·34	43·46	43·58	43·70	43·82	43·94	44·06
47	43·91	44·03	44·15	44·27	44·40	44·52	44·65	44·77	44·90	45·03
48	44·84	44·96	45·09	45·22	45·35	45·47	45·60	45·72	45·85	45·98
49	45·78	45·91	46·04	46·17	46·30	46·42	46·55	46·67	46·80	46·94
50	46·72	46·85	46·97	47·11	47·24	47·36	47·50	47·63	47·77	47·90

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	710	712	714	716	718	720	722	724	726	728
51	47·65	47·79	47·92	48·05	48·18	48·31	48·45	48·59	48·73	48·86
52	48·58	48·72	48·85	48·99	49·13	49·26	49·40	49·54	49·68	49·82
53	49·52	49·66	49·79	49·93	50·07	50·21	50·35	50·48	50·64	50·78
54	50·45	50·59	50·73	50·87	51·01	51·15	51·30	51·44	51·59	51·73
55	51·38	51·53	51·67	51·82	51·96	52·10	52·25	52·39	52·54	52·69
56	52·32	52·47	52·61	52·76	52·91	53·05	53·20	53·35	53·50	53·65
57	53·25	53·41	53·55	53·70	53·85	54·00	54·15	54·30	54·45	54·60
58	54·19	54·34	54·49	54·64	54·79	54·94	55·10	55·25	55·41	55·56
59	55·13	55·28	55·43	55·59	55·74	55·89	56·05	56·21	56·37	56·52
60	56·07	56·22	56·37	56·53	56·69	56·84	57·00	57·16	57·32	57·47
61	57·00	57·15	57·31	57·47	57·63	57·79	57·95	58·11	58·27	58·43
62	57·93	58·09	58·25	58·41	58·58	58·74	58·90	59·06	59·23	59·39
63	58·87	59·03	59·19	59·35	59·52	59·68	59·85	60·01	60·18	60·35
64	59·80	59·96	60·13	60·30	60·47	60·63	60·80	60·97	61·14	61·30
65	60·74	60·90	61·07	61·24	61·41	61·58	61·75	61·92	62·09	62·26
66	61·67	61·84	62·01	62·18	62·35	62·52	62·70	62·87	63·05	63·22
67	62·60	62·77	62·95	63·12	63·30	63·47	63·65	63·82	64·00	64·18
68	63·54	63·71	63·89	64·06	64·24	64·42	64·60	64·78	64·96	65·13
69	64·47	64·65	64·83	65·01	65·19	65·37	65·55	65·73	65·91	66·09
70	65·40	65·58	65·77	65·95	66·14	66·32	66·50	66·68	66·87	67·05
71	66·34	66·52	66·71	66·89	67·08	67·26	67·45	67·63	67·82	68·01
72	67·27	67·46	67·65	67·83	68·02	68·21	68·40	68·59	68·78	68·97
73	68·20	68·39	68·58	68·77	68·97	69·16	69·35	69·54	69·73	69·92
74	69·14	69·33	69·53	69·72	69·92	70·11	70·30	70·49	70·69	70·88
75	70·07	70·27	70·47	70·66	70·86	71·05	71·25	71·44	71·64	71·84

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	710	712	714	716	718	720	722	724	726	728
76	71·01	71·21	71·41	71·60	71·80	72·00	72·20	72·40	72·60	72·80
77	71·94	72·14	72·34	72·54	72·75	72·95	73·15	73·35	73·55	73·75
78	72·87	73·07	73·28	73·48	73·69	73·89	74·10	74·30	74·51	74·71
79	73·80	74·01	74·22	74·42	74·63	74·84	75·05	75·25	75·46	75·67
80	74·74	74·94	75·16	75·37	75·58	75·78	76·00	76·21	76·42	76·63
81	75·67	75·88	76·10	76·31	76·53	76·74	76·95	77·16	77·37	77·58
82	76·60	76·82	77·04	77·25	77·47	77·68	77·90	78·11	78·33	78·54
83	77·54	77·76	77·98	78·19	78·41	78·63	78·85	79·07	79·28	79·50
84	78·47	78·69	78·91	79·13	79·35	79·57	79·80	80·02	80·24	80·46
85	79·41	79·63	79·86	80·08	80·31	80·53	80·75	80·97	81·19	81·41
86	80·34	80·57	80·80	81·02	81·25	81·47	81·70	81·92	82·15	82·37
87	81·28	81·50	81·74	81·96	82·19	82·42	82·65	82·87	83·10	83·33
88	82·21	82·44	82·68	82·90	83·13	83·36	83·60	83·83	84·06	84·29
89	83·15	83·38	83·62	83·85	84·08	84·31	84·55	84·78	85·02	85·25
90	84·09	84·31	84·56	84·79	85·03	85·26	85·50	85·73	85·98	86·21
91	85·02	85·25	85·50	85·73	85·98	86·21	86·45	86·69	86·93	87·17
92	85·95	86·19	86·44	86·68	86·92	87·16	87·40	87·64	87·89	88·13
93	86·89	87·12	87·38	87·62	87·87	88·11	88·35	88·59	88·84	89·08
94	87·82	88·06	88·32	88·56	88·81	89·05	89·30	89·54	89·80	90·04
95	88·76	89·01	89·26	89·50	89·75	90·00	90·25	90·50	90·75	91·00
96	80·69	89·94	90·20	90·45	90·70	90·95	91·20	91·45	91·70	91·95
97	90·62	90·87	91·13	91·38	91·64	91·89	92·15	92·40	92·96	92·91
98	91·56	91·82	92·07	92·33	92·59	92·84	93·10	93·35	93·62	93·87
99	92·49	92·75	93·01	93·26	93·53	93·79	94·05	94·31	94·57	94·83
100	93·42	93·68	93·95	94·21	94·47	94·74	95·00	95·26	95·53	95·79

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	730	732	734	736	738	740	742	744	746	748
1	0·961	0·963	0·966	0·968	0·971	0·974	0·976	0·979	0·982	0·984
2	1·921	1·926	1·932	1·937	2·942	1·947	1·953	1·958	1·963	1·968
3	2·882	2·889	2·898	2·905	2·913	2·921	2·929	2·937	2·945	2·953
4	3·842	3·852	3·864	3·874	3·884	3·895	3·905	3·916	3·926	3·937
5	4·803	4·816	4·830	4·842	4·855	4·868	4·882	4·895	4·908	4·921
6	5·763	5·779	5·796	5·810	5·826	5·842	5·858	5·874	5·890	5·905
7	6·724	6·742	6·762	6·779	6·797	6·816	6·834	6·853	6·871	6·889
8	7·684	7·705	7·728	7·747	7·768	7·790	7·810	7·832	7·853	7·874
9	8·645	8·668	8·693	8·716	8·739	8·763	8·787	8·811	8·834	8·858
10	9·61	9·63	9·66	9·68	9·71	9·74	9·76	9·79	9·82	9·84
11	10·57	10·59	10·62	10·65	10·68	10·71	10·74	10·77	10·80	10·82
12	11·53	11·56	11·59	11·62	11·65	11·68	11·71	11·75	11·78	11·81
13	12·49	12·52	12·55	12·59	12·62	12·66	12·69	12·73	12·76	12·79
14	13·45	13·48	13·52	13·56	13·59	13·63	13·66	13·70	13·74	17·78
15	14·41	14·44	14·48	14·52	14·56	14·60	14·64	14·69	14·73	14·77
16	15·37	15·41	15·45	15·49	15·53	15·58	15·62	15·67	15·71	15·75
17	16·33	16·37	16·41	16·46	16·50	16·55	16·60	16·65	16·69	16·73
18	17·29	17·33	17·38	17·43	17·47	17·52	17·57	17·62	17·67	17·72
19	18·25	18·29	18·35	18·40	18·45	18·50	18·55	18·60	18·65	18·70
20	19·21	19·26	19·32	19·37	19·42	19·47	19·53	19·58	19·63	19·68
21	20·17	20·22	20·28	20·24	20·39	20·44	20·50	20·56	20·61	20·66
22	21·13	21·19	21·25	21·31	21·36	21·42	21·48	21·54	21·59	21·65
23	22·09	22·15	22·21	22·27	22·33	22·39	22·45	22·51	22·57	22·64
24	23·05	23·11	23·18	23·24	23·30	23·36	23·43	23·50	23·56	23·63
25	24·01	24·07	24·14	24·21	24·27	24·34	24·41	24·48	24·54	24·61

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	730	732	734	736	738	740	742	744	746	748
26	24·97	25·04	25·11	25·18	25·24	25·31	25·38	25·45	25·52	25·59
27	25·93	26·00	26·07	26·14	26·21	26·28	26·36	26·43	26·50	26·58
28	26·89	26·96	27·04	27·12	27·18	27·26	27·33	27·41	27·48	27·56
29	27·85	27·92	28·00	28·08	28·15	28·23	28·31	28·39	28·47	28·55
30	28·82	28·89	28·97	29·05	29·13	29·21	29·29	29·37	29·45	29·53
31	29·78	29·86	29·94	30·02	30·10	30·18	30·26	30·35	30·43	30·51
32	30·74	30·82	30·91	30·99	31·07	31·15	31·24	31·33	31·41	31·50
33	31·70	31·78	31·87	31·96	32·04	32·13	32·21	32·30	32·39	32·48
34	32·66	32·75	32·84	32·93	33·01	33·10	33·19	33·28	33·37	33·46
35	33·62	33·71	33·80	33·89	33·98	34·07	34·17	34·27	34·36	34·45
36	34·58	34·67	34·77	34·86	34·95	35·05	35·15	35·25	35·34	35·43
37	35·54	35·63	35·73	35·83	35·92	36·02	36·12	36·22	36·32	36·42
38	36·50	36·60	36·70	36·80	36·90	37·00	37·10	37·20	37·30	37·40
39	37·47	37·57	37·67	37·77	37·87	37·97	38·07	38·18	38·28	38·39
40	38·42	38·52	38·64	38·74	38·84	38·95	39·05	39·16	39·26	39·37
41	39·38	39·48	39·60	39·71	39·81	39·92	40·02	40·14	40·24	40·36
42	40·34	40·44	40·56	40·68	40·78	40·89	41·00	41·12	41·22	41·34
43	41·30	41·41	41·53	41·64	41·75	41·86	41·97	42·10	42·20	42·32
44	42·27	42·38	42·50	42·62	42·73	42·84	42·95	43·07	43·18	43·30
45	43·22	43·34	43·46	43·58	43·69	43·81	43·93	44·06	44·17	44·29
46	44·18	44·30	44·42	44·54	44·66	44·78	44·90	45·03	45·15	45·27
47	45·15	45·26	45·39	45·52	45·64	45·76	45·88	46·01	46·13	46·26
48	46·10	46·23	46·36	46·49	46·61	46·73	46·85	46·99	47·12	47·24
49	47·06	47·19	47·32	47·44	47·57	47·70	47·83	47·97	48·10	48·23
50	48·03	48·16	48·30	48·42	48·55	48·68	48·82	48·95	49·08	49·21

Table for Reduction of Volumes of Gases to a Pressure of 760 mm.—*continued.*

760	730	732	734	736	738	740	742	744	746	748
51	48·99	49·12	49·26	49·39	49·52	49·65	49·79	49·93	50·06	50·19
52	49·96	50·08	50·22	50·36	50·49	50·63	50·77	50·91	51·04	51·18
53	50·91	51·05	51·19	51·33	51·46	51·60	51·75	51·89	52·02	52·16
54	51·87	52·01	52·16	52·30	52·44	52·58	52·72	52·87	53·01	53·15
55	52·83	52·98	53·13	53·27	53·41	53·55	53·70	53·85	53·99	54·14
56	53·79	53·94	54·09	54·23	54·37	54·52	54·68	54·83	54·97	55·11
57	54·75	54·90	55·05	55·20	55·35	55·50	55·65	55·80	55·95	56·10
58	55·71	55·86	56·02	56·17	56·32	56·47	56·63	56·78	56·93	57·08
59	56·67	56·83	56·99	57·14	57·29	57·44	57·60	57·76	57·92	58·07
60	57·63	57·79	57·95	58·10	58·26	58·42	58·58	58·74	58·90	59·05
61	58·59	58·75	58·91	59·07	59·23	59·39	59·56	59·72	59·88	60·04
62	59·55	59·72	59·88	60·04	60·20	60·36	60·53	60·70	60·86	61·02
63	60·51	60·68	60·85	61·01	61·17	61·34	61·51	61·68	61·84	62·00
64	61·47	61·64	61·81	61·98	62·15	62·32	62·49	62·66	62·82	62·99
65	62·43	62·60	62·77	62·94	63·11	63·28	63·46	63·64	63·81	63·98
66	63·39	63·57	63·74	63·91	64·08	64·26	64·44	64·62	64·79	64·96
67	64·35	64·53	64·71	64·88	65·05	65·23	65·41	65·59	65·77	65·94
68	65·31	65·50	65·68	65·85	66·02	66·20	66·38	66·56	66·74	66·92
69	66·27	66·45	66·64	66·82	67·00	67·18	67·37	67·55	67·73	67·91
70	67·24	67·42	67·61	67·79	67·97	68·16	68·34	68·53	68·71	68·89
71	68·20	68·39	68·58	68·76	68·94	69·13	69·32	69·51	69·69	69·88
72	69·16	69·35	69·54	69·73	69·92	70·11	70·30	70·49	70·68	70·86
73	70·12	70·31	70·51	70·69	70·88	71·08	71·27	71·47	71·66	71·85
74	71·08	71·28	71·48	71·66	71·85	72·05	72·25	72·45	72·64	72·83
75	72·04	72·24	72·44	72·63	72·82	73·02	73·22	73·42	73·62	73·82

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	730	732	734	736	738	740	742	744	746	748
76	73·00	73·20	73·40	73·60	73·80	74·00	74·20	74·40	74·60	74·80
77	73·96	74·17	74·37	74·57	74·77	74·97	75·18	75·39	75·59	75·79
78	74·92	75·12	75·33	75·53	75·74	75·95	76·16	76·37	76·57	76·77
79	75·88	76·09	76·30	76·50	76·71	76·92	77·13	77·34	77·55	77·75
80	76·84	77·05	77·27	77·47	77·68	77·90	78·10	78·32	78·53	78·74
81	77·80	78·02	78·23	78·44	78·65	78·87	79·08	79·30	79·51	79·72
82	78·76	78·98	79·20	79·41	79·62	79·84	80·06	80·28	80·50	80·71
83	79·72	79·94	80·16	80·38	80·60	80·82	81·04	81·26	81·48	81·69
84	80·68	80·90	81·12	81·34	81·56	81·79	82·01	82·24	82·46	82·68
85	81·64	81·87	82·10	82·31	82·53	82·76	82·99	83·22	83·44	83·66
86	82·60	82·83	83·06	83·28	83·50	83·73	83·97	84·20	84·42	84·64
87	83·56	83·79	84·02	84·25	84·48	84·71	84·94	85·17	85·40	85·62
88	84·52	84·76	85·00	85·22	85·45	85·68	85·92	86·15	86·38	86·61
89	85·48	85·72	85·96	86·19	86·42	86·66	86·89	87·13	87·36	87·59
90	86·45	86·68	86·93	87·16	87·39	87·63	87·87	88·11	88·34	88·58
91	87·41	87·65	87·89	88·12	88·36	88·61	88·85	89·09	89·33	89·56
92	88·37	88·61	88·86	89·09	89·33	89·58	89·82	90·07	90·31	90·55
93	89·33	89·57	89·82	90·06	90·30	90·55	90·80	91·05	91·29	91·53
94	90·29	90·54	90·79	91·03	91·27	91·53	91·78	92·03	92·27	92·51
95	91·25	91·50	91·75	92·00	92·25	92·50	92·75	93·00	93·25	93·50
96	92·21	92·46	92·72	92·97	93·22	93·47	93·73	93·98	94·23	94·48
97	93·17	93·43	93·68	93·93	94·19	94·45	94·71	94·96	95·22	95·47
98	94·13	94·39	94·65	94·90	95·16	95·42	95·68	95·94	96·20	96·45
99	95·09	95·35	95·61	95·87	96·13	96·39	96·66	96·92	97·18	97·43
100	96·05	96·32	96·58	96·84	97·11	97·37	97·63	97·89	98·16	98·42

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	750	752	754	756	758	762	764	766	768	770
1	0·987	0·989	0·992	0·995	0·997	1·003	1·005	1·008	1·011	1·013
2	1·974	1·979	1·984	1·989	1·995	2·005	2·011	2·016	2·021	2·026
3	2·960	2·968	2·976	2·984	2·992	3·007	3·016	3·024	3·032	3·039
4	3·947	3·958	3·968	3·979	3·990	4·010	4·021	4·032	4·042	4·052
5	4·934	4·947	4·960	4·974	4·987	5·013	5·026	5·040	5·053	5·066
6	5·921	5·937	5·952	5·968	5·984	6·016	6·032	6·047	6·063	6·079
7	6·908	6·926	6·944	6·963	6·982	7·018	7·037	7·055	7·074	7·092
8	7·894	7·916	7·936	7·958	7·979	8·021	8·042	8·063	8·084	8·106
9	8·881	8·905	8·929	8·952	8·977	9·023	9·048	9·071	9·095	9·119
10	9·87	9·89	9·92	9·95	9·97	10·03	10·05	10·08	10·11	10·13
11	10·85	10·88	10·91	10·94	10·97	11·03	11·06	11·09	11·12	11·14
12	11·84	11·87	11·90	11·94	11·97	12·04	12·07	12·10	12·13	12·16
13	12·83	12·86	12·89	12·93	12·96	13·04	13·07	13·10	13·14	13·17
14	13·82	13·85	13·88	13·92	13·96	14·04	14·07	14·11	14·15	14·17
15	14·81	14·84	14·87	14·92	14·96	15·04	15·08	15·12	15·16	15·19
16	15·79	15·83	15·87	15·91	15·95	16·05	16·09	16·13	16·17	16·21
17	16·78	16·82	16·86	16·91	16·95	17·05	17·09	17·14	17·18	17·22
18	17·77	17·81	17·85	17·90	17·95	18·05	18·10	18·15	18·19	18·23
19	18·75	18·80	18·85	18·90	18·95	19·05	19·10	19·15	19·20	19·25
20	19·74	19·79	19·84	19·89	19·95	20·05	20·11	20·16	20·21	20·26
21	20·72	20·77	20·83	20·89	20·94	21·05	21·11	21·17	21·22	21·27
22	21·71	21·76	21·82	21·88	21·94	22·06	22·12	22·18	22·23	22·28
23	22·70	22·75	22·81	22·88	22·94	23·06	23·12	23·18	23·24	23·30
24	23·69	23·74	23·80	23·87	23·93	24·06	24·13	24·19	24·25	24·31
25	24·67	24·73	24·80	24·87	24·93	25·06	25·13	25·20	25·26	25·32

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	750	752	754	756	758	762	764	766	768	770
26	25·66	25·72	25·79	25·86	25·93	26·06	26·14	26·21	26·27	26·34
27	26·65	26·71	26·78	26·86	26·93	27·07	27·15	27·22	27·28	28·35
28	27·63	27·70	27·77	27·85	27·92	28·07	28·15	28·23	28·29	28·36
29	28·62	28·69	28·76	28·84	28·92	29·07	29·16	29·24	29·30	29·37
30	29·60	29·68	29·76	29·84	29·92	30·07	30·16	30·24	30·32	30·39
31	30·59	30·67	30·75	30·84	30·92	31·08	31·17	31·25	31·33	31·41
32	31·58	31·66	31·74	31·83	31·92	32·08	32·17	32·26	32·34	32·42
33	32·56	32·65	32·73	32·82	32·91	33·08	33·18	33·27	33·35	33·43
34	33·55	33·64	33·73	33·82	33·91	34·09	34·18	34·28	34·36	34·45
35	34·54	34·63	34·72	34·82	34·91	35·09	35·19	35·28	35·37	35·46
36	35·52	35·62	35·71	35·81	35·91	36·09	36·19	36·29	36·38	36·47
37	36·51	36·61	36·71	36·81	36·90	37·09	37·20	37·30	37·39	37·49
38	37·50	37·60	37·70	37·80	37·90	38·10	38·20	38·30	38·40	38·50
39	38·49	38·59	38·69	38·80	38·90	39·10	39·21	39·31	39·41	39·51
40	39·47	39·58	39·68	39·79	39·90	40·10	40·21	40·32	40·42	40·52
41	40·46	40·56	40·67	40·79	40·89	41·11	41·22	41·33	41·43	41·54
42	41·44	41·55	41·66	41·78	41·89	42·11	42·22	42·34	42·44	42·55
43	42·43	42·54	42·66	42·78	42·89	43·11	43·23	43·35	43·45	43·56
44	43·42	43·53	43·65	43·77	43·89	44·12	44·23	44·35	44·46	44·58
45	44·40	44·52	44·64	44·76	44·88	45·12	45·24	45·36	45·47	45·59
46	45·39	45·51	45·63	45·76	45·88	46·12	46·24	46·36	46·48	46·60
47	46·38	46·50	46·63	46·76	46·88	47·12	47·25	47·38	47·49	47·61
48	47·36	47·49	47·62	47·75	47·87	48·13	48·25	48·39	48·51	48·63
49	48·35	48·48	48·61	48·74	48·87	49·13	49·26	49·40	49·52	49·64
50	49·34	49·47	49·60	49·74	49·87	50·13	50·26	50·40	50·53	50·66

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	750	752	754	756	758	762	764	766	768	770
51	50·33	50·46	50·60	50·74	50·87	51·14	51·27	51·41	51·54	51·67
52	51·32	51·45	51·59	51·73	51·87	52·14	52·28	52·42	52·55	52·68
53	52·30	52·44	52·58	52·73	52·87	53·14	53·28	53·42	53·56	53·70
54	53·29	53·43	53·57	53·72	53·86	54·14	54·28	54·43	54·57	54·72
55	54·28	54·42	54·56	54·71	54·86	55·15	55·29	55·44	55·58	55·73
56	55·26	55·41	55·56	55·71	55·86	56·15	56·29	56·45	56·59	56·74
57	56·25	56·40	56·55	56·70	56·85	57·15	57·30	57·45	57·60	57·76
58	57·24	57·39	57·54	57·69	57·85	58·15	58·30	58·46	58·61	58·77
59	58·22	58·38	58·53	58·69	58·85	59·16	59·31	59·47	59·62	59·78
60	59·21	59·37	59·52	59·68	59·84	60·16	60·32	60·47	60·63	60·79
61	60·20	60·36	60·52	60·68	60·84	61·16	61·32	61·48	61·64	61·81
62	61·19	61·35	61·51	61·67	61·84	62·16	62·33	62·49	62·65	62·82
63	62·17	62·34	62·50	62·67	62·83	63·17	63·33	63·50	63·67	63·84
64	63·16	63·33	63·49	63·66	63·83	64·17	64·34	64·51	64·68	64·85
65	64·15	64·32	64·49	64·66	64·83	65·17	65·34	65·51	65·69	65·86
66	65·13	65·31	65·48	65·65	65·82	66·17	66·35	66·52	66·70	66·88
67	66·12	66·30	66·47	66·64	66·82	67·18	67·35	67·53	67·71	67·89
68	67·10	67·29	67·46	67·64	67·82	68·18	68·36	68·54	68·72	68·90
69	68·09	68·28	68·45	68·63	68·82	69·18	69·36	69·54	69·73	69·91
70	69·08	69·26	69·44	69·63	69·82	70·18	70·37	70·55	70·74	70·92
71	70·07	70·25	70·43	70·62	70·81	71·19	71·37	71·56	71·75	71·94
72	71·05	71·24	71·43	71·62	71·81	72·19	72·38	72·57	72·76	72·95
73	72·04	72·23	72·42	72·61	72·81	73·19	73·38	73·57	73·77	73·97
74	73·03	73·22	73·41	73·61	73·80	74·19	74·39	74·58	74·78	74·98
75	74·01	74·21	74·40	74·60	74·80	75·20	75·39	75·59	75·79	75·99

TABLE FOR REDUCTION OF VOLUMES OF GASES TO A PRESSURE OF 760 MM.—*continued.*

760	750	752	754	756	758	762	764	766	768	770
76	75·00	75·20	75·40	75·60	75·80	76·20	76·40	76·60	76·80	77·01
77	75·99	76·19	76·39	76·59	76·79	77·20	77·40	77·60	77·81	78·02
78	76·97	77·18	77·38	77·58	77·79	78·20	78·41	78·61	78·82	79·03
79	77·96	78·17	78·37	78·58	78·79	79·21	79·41	79·62	79·83	80·04
80	78·94	79·16	79·36	79·58	79·79	80·21	80·42	80·63	80·84	81·06
81	79·93	80·15	80·35	80·57	80·79	81·21	81·42	81·64	81·85	82·07
82	80·92	81·14	81·35	81·56	81·78	82·21	82·43	82·65	82·87	83·09
83	81·91	82·13	82·34	82·56	82·78	83·22	83·44	83·66	83·88	84·10
84	82·90	83·12	83·34	83·56	83·78	84·22	84·44	84·66	84·89	85·11
85	83·88	84·11	84·33	84·55	84·78	85·22	85·45	85·67	85·90	86·13
86	84·87	85·10	85·32	85·55	85·78	86·22	86·46	86·67	86·91	87·14
87	85·85	86·08	86·31	86·54	86·77	87·23	87·46	87·68	87·92	88·15
88	86·84	87·07	87·30	87·54	87·77	88·23	88·47	88·69	88·93	89·17
89	87·82	88·06	88·29	88·53	88·77	89·23	89·47	89·70	89·94	90·18
90	88·81	89·05	89·29	89·52	89·77	90·23	90·48	90·71	90·95	91·19
91	89·80	90·04	90·28	90·52	90·76	91·24	91·48	91·72	91·96	92·21
92	90·79	91·03	91·27	91·51	91·76	92·24	92·49	92·73	92·97	93·22
93	91·77	92·02	92·26	92·51	92·76	93·24	93·49	93·74	93·98	94·23
94	92·76	93·01	93·26	93·50	93·75	94·24	94·49	94·74	94·99	95·24
95	93·74	94·00	94·25	94·50	94·75	95·25	95·50	95·75	96·00	96·26
96	94·73	94·98	95·24	95·49	95·75	96·25	96·51	96·76	97·01	97·27
97	95·72	95·97	96·23	96·49	96·75	97·25	97·51	97·77	98·02	98·29
98	96·70	96·96	97·22	97·48	97·74	98·25	98·52	98·77	99·03	99·30
99	97·69	97·95	98·21	98·48	98·74	99·26	99·52	99·78	100·04	100·31
100	98·68	98·95	99·21	99·47	99·74	100·26	100·53	100·79	101·05	101·32

TABLE FOR CORRECTION OF VOLUMES OF GASES FOR TEMPERATURE.

I. The volume at 0° C. being known, to find the corresponding volume at any temperature between 0° and 30° C., multiply the number of c.c. by the factor in the first column, and add the result to the original volume.

Temp.	Correction for 1° C.	Multiples of Correction.							
		2	3	4	5	6	7	8	9
1	·00369	·00738	·01107	·01476	·01845	·02214	·02583	·02952	·03321
2	·00742	·01484	·02226	·02968	·03710	·04452	·05194	·05936	·06678
3	·0109	·0218	·0327	·0436	·0545	·0654	·0763	·0872	·0981
4	·0146	·0292	·0438	·0584	·0730	·0876	·1622	·1168	·1314
5	·0183	·0366	·0549	·0732	·0915	·1098	·1281	·1464	·1647
6	·0219	·0438	·0657	·0876	·1095	·1314	·1533	·1752	·1971
7	·0256	·0512	·0768	·1024	·1280	·1536	·1792	·2048	·2304
8	·0293	·0586	·0879	·1172	·1465	·1758	·2051	·2344	·2637
9	·0330	·0660	·0990	·1320	·1650	·1980	·2310	·2640	·2970
10	·0366	·0732	·1098	·1464	·1830	·2196	·2562	·2928	·3294
11	·0403	·0806	·1209	·1612	·2015	·2418	·2821	·3224	·3627
12	·0440	·0880	·1320	·1760	·2200	·2640	·3080	·3520	·3960
13	·0475	·0950	·1425	·1900	·2375	·2850	·3325	·3800	·4275
14	·0511	·1022	·1533	·2044	·2555	·3066	·3577	·4088	·4599
15	·0548	·1096	·1644	·2192	·2740	·3288	·3836	·4384	·4932
16	·0585	·1170	·1755	·2340	·2925	·3510	·4095	·4680	·5265
17	·0622	·1244	·1866	·2488	·3110	·3732	·4354	·4976	·5598
18	·0660	·1320	·1980	·2640	·3300	·3960	·4620	·5280	·5940
19	·0696	·1392	·2088	·2784	·3480	·4176	·4872	·5568	·6264
20	·0732	·1464	·2196	·2928	·3660	·4392	·5124	·5856	·6588
21	·0770	·1540	·2310	·3080	·3850	·4620	·5390	·6160	·6930
22	·0804	·1608	·2412	·3216	·4020	·4824	·5628	·6432	·7236
23	·0842	·1684	·2526	·3368	·4210	·5052	·5894	·6736	·7578
24	·0876	·1752	·2628	·3504	·4380	·5256	·6132	·7008	·7884
25	·0914	·1828	·2742	·3656	·4570	·5484	·6398	·7312	·8226
26	·0952	·1904	·2856	·3808	·4760	·5712	·6664	·7616	·8568
27	·0988	·1976	·2964	·3952	·4940	·5928	·6916	·7904	·8892
28	·1025	·2050	·3075	·4100	·5125	·6150	·7175	·8209	·9225
29	·1063	·2126	·3189	·4252	·5315	·6378	·7441	·8504	·9567
30	·1100	·2200	·3300	·4100	·5500	·6600	·7700	·8800	·9900

TABLE FOR CORRECTION OF VOLUMES OF GASES FOR TEMPERATURE.

II. The volume at any temperature between 0° and 30° C. being known, to find the corresponding volume at 0° C., multiply the number of c.c. by the factor in the first column and subtract the result from the original volume.

Temp.	Correction for 1 c.c.	Multiples of Correction.							
		2	3	4	5	6	7	8	9
1	·0037	·0074	·0111	·0148	·0185	·0222	·0259	·0296	·0333
2	·0073	·0146	·0219	·0292	·0365	·0438	·0511	·0584	·0657
3	·0109	·0218	·0327	·0436	·0545	·0654	·0763	·0872	·0981
4	·0144	·0288	·0432	·0576	·0720	·0864	·1008	·1152	·1296
5	·0180	·0360	·0540	·0720	·0900	·1080	·1260	·1440	·1620
6	·0215	·0430	·0645	·0860	·1075	·1290	·1505	·1720	·1935
7	·0250	·0500	·0750	·1000	·1250	·1500	·1750	·2000	·2250
8	·0284	·0568	·0852	·1136	·1420	·1704	·1988	·2272	·2556
9	·0319	·0638	·0957	·1276	·1595	·1914	·2233	·2552	·2871
10	·0353	·0706	·1059	·1412	·1765	·2118	·2471	·2824	·3177
11	·0387	·0774	·1161	·1548	·1935	·2322	·2709	·3096	·3483
12	·0421	·0842	·1263	·1684	·2105	·2526	·2947	·3368	·3789
13	·0454	·0908	·1362	·1816	·2270	·2724	·3178	·3632	·4086
14	·0487	·0974	·1461	·1948	·2435	·2922	·3409	·3896	·4383
15	·0520	·1040	·1560	·2080	·2600	·3120	·3640	·4160	·4680
16	·0553	·1106	·1659	·2212	·2765	·3318	·3871	·4424	·4977
17	·0586	·1172	·1758	·2344	·2930	·3516	·4102	·4688	·5274
18	·0618	·1236	·1854	·2472	·3090	·3708	·4326	·4944	·5562
19	·0651	·1302	·1953	·2604	·3255	·3906	·4557	·5208	·5859
20	·0682	·1364	·2046	·2728	·3410	·4092	·4774	·5456	·6138
21	·0714	·1428	·2142	·2856	·3570	·4284	·4998	·5712	·6426
22	·0745	·1490	·2235	·2980	·3725	·4470	·5215	·5960	·6705
23	·0776	·1552	·2328	·3104	·3880	·4656	·5432	·6208	·6984
24	·0807	·1614	·2421	·3228	·4035	·4842	·5649	·6456	·7263
25	·0838	·1676	·2514	·3352	·4190	·5028	·5866	·6704	·7542
26	·0869	·1738	·2607	·3476	·4345	·5214	·6083	·6952	·7821
27	·0899	·1798	·2697	·3596	·4495	·5394	·6293	·7192	·8091
28	·0930	·1860	·2790	·3720	·4650	·5580	·6510	·7440	·8370
29	·0960	·1920	·2880	·3840	·4800	·5760	·6720	·7680	·8640
30	·0991	·1982	·2973	·3964	·4955	·5946	·6937	·7928	·8919

TABLE FOR CORRECTION OF VOLUMES OF GASES TO NORMAL BAROMETER PRESSURE OF 760 M.M.

Multiply the observed number of c.c. by the factor opposite the observed pressure and add or subtract the result.

Pressure in m.m.	Factor.	Pressure in m.m.	Factor.	Pressure in m.m.	Factor.
710	·06579	730	·03947	750	·01316
711	·06447	731	·03816	751	·01184
712	·06316	732	·03684	752	·01053
713	·06184	733	·03553	753	·00921
714	·06052	734	·03421	754	·00784
715	·05921	735	·03289	755	·00658
716	·05789	736	·03153	756	·00526
717	·05658	737	·03026	757	·00395
718	·05525	738	·02895	758	·00263
719	·05395	739	·02763	759	·00132
720	·05263	740	·02631	760	·00000
721	·05132	741	·02500	761	·00132
722	·05000	742	·02368	762	·00263
723	·04868	743	·02237	763	·00395
724	·04737	744	·02105	764	·00526
725	·04605	745	·01973	765	·00658
726	·04474	746	·01842	766	·00784
727	·04342	747	·01710	767	·00921
728	·04210	748	·01579	768	·01053
729	·04079	749	·01447	769	·01184

TENSION OF AQUEOUS VAPOUR IN MILLIMETRES OF MERCURY, FROM − 9·9° TO + 35° C.

°	mm.	°	mm.	°	mm.	°	mm.
−9·9	2·096	−7·3	2·603	−4·7	3·206	−2·1	3·925
·8	·114	·2	·624	·6	·231	−2·0	·955
·7	·132	·1	·645	·5	·257	−1·9	3·985
·6	·150	−7·0	·666	−4·4	·283	·8	4·016
·5	·168	−6·9	2·688	·3	·309	·7	·047
−9·4	·186	·8	·710	·2	·335	·6	·078
·3	·204	·7	·732	·1	·361	·5	·109
·2	·223	·6	·754	−4·0	·387	−1·4	·140
·1	·243	·5	·776	−3·9	3·414	·3	·171
−9·0	·261	−6·4	·798	·8	·441	·2	·203
−8·9	2·280	·3	·821	·7	·468	·1	·235
·8	·299	·2	·844	·6	·495	−1·0	·267
·7	·318	·1	·867	·5	·522	−0·9	4·299
·6	·337	−6·0	·890	−3·4	·550	·8	·331
·5	·356	−5·9	·914	·3	·578	·7	·364
−8·4	·376	·8	·938	·2	·606	·6	·397
·3	·396	·7	·962	·1	·634	·5	·430
·2	·416	·6	·986	−3·0	·664	−0·4	·463
·1	·436	·5	3·010	−2·9	3·691	·3	·497
−8·0	·456	−5·4	3·034	·8	·720	·2	·531
−7·9	2·477	·3	·058	·7	·749	·1	·565
·8	·498	·2	·082	·6	·778	−0·0	4·600
·7	·519	·1	·106	·5	·807	+0·0	4·600
·6	·540	−5·0	·131	−2·4	·836	·1	·633
·5	·561	−4·9	3·156	·3	·865	·2	·667
−7·4	·582	·8	·181	·2	·895	·3	·700

TENSION OF AQUEOUS VAPOUR—*continued.*

°	mm.	°	mm.	°	mm.	°	mm.
+.4	4·733	3·3	5·807	6·2	7·095	9·1	8·632
0·5	·767	·4	·848	·3	·144	·2	·690
·6	·801	3·5	·889	·4	·193	·3	·748
·7	·836	·6	·930	6·5	·242	·4	·807
·8	·871	·7	·972	·6	·292	9·5	·865
0·9	·905	·8	6·014	·7	·342	·6	·925
1·0	·940	3·9	·055	·8	·392	·7	·985
·1	·975	4·0	6·097	6·9	·442	·8	9·045
·2	5·011	·1	·140	7·0	7·492	9·9	·105
·3	·047	·2	·183	·1	·544	10·0	9·165
·4	·082	·3	·226	·2	·595	·1	·227
1·5	·118	·4	·270	·3	·647	·2	·288
·6	·155	4·5	·313	·4	·699	·3	·350
·7	·191	·6	·357	7·5	7·751	·4	·412
·8	·228	·7	·401	·6	·804	10·5	·474
1·9	·265	·8	·445	·7	·857	·6	·537
2·0	5·302	4·9	·490	·8	·910	·7	·601
·1	·340	5·0	6·534	·9	·964	·8	·665
·2	·378	·1	·580	8·0	8·017	10·9	·728
·3	·416	·2	·625	·1	·072	11·0	9·792
·4	·454	·3	·671	·2	·126	·1	·857
2·5	·491	·4	·717	·3	·181	·2	·923
·6	·530	5·5	·763	·4	·236	·3	·989
·7	·569	·6	·810	8·5	·291	·4	10·054
·8	·608	·7	·857	·6	·347	11·5	·120
2·9	·647	·8	·904	·7	·404	·6	·187
3·0	5·687	5·9	·951	·8	·461	·7	·255
·1	·727	6·0	6·998	8·9	·517	·8	·322
·2	·767	·1	7·047	9·0	8·574	11·9	·389

TENSION OF AQUEOUS VAPOUR—*continued.*

°	mm.	°	mm.	°	mm.	°	mm.
+12·0	10·457	14·9	12·619	17·8	15·167	20·7	18·159
·1	·526	15·0	12·699	·9	·262	·8	·271
·2	·596	·1	·781	18·0	15·357	20·9	·383
·3	·665	·2	·864	·1	·454	21·0	18·495
·4	·734	·3	·947	·2	·552	·1	·610
12·5	10·804	·4	13·029	·3	·650	·2	·724
·6	·875	15·5	·112	·4	·747	·3	·839
·7	·947	·6	·197	18·5	·845	·4	·954
·8	11·019	·7	·281	·6	·945	21·5	19·069
·9	·090	·8	·366	·7	16·045	·6	·187
13·0	11·162	15·9	·451	·8	·145	·7	·305
·1	·235	16·0	13·536	18·9	·246	·8	·423
·2	·309	·1	·623	19·0	16·346	21·9	·541
·3	·383	·2	·710	·1	·449	22·0	19·659
·4	·456	·3	·797	·2	·552	·1	·780
13·5	·530	·4	·885	·3	·655	·2	·901
·6	·605	16·5	·972	·4	·758	·3	20·022
·7	·681	·6	14·062	19·5	·861	·4	·143
·8	·757	·7	·151	·6	·967	22·5	·265
13·9	·832	·8	·241	·7	17·073	·6	·389
14·0	11·908	16·9	·331	·8	·179	·7	·514
·1	·986	17·0	14·421	19·9	·285	·8	·639
·2	12·064	·1	·513	20·0	17·391	22·9	·763
·3	·142	·2	·605	·1	·500	23·0	20·888
·4	·220	·3	·697	·2	·608	·1	21·016
14·5	12·298	·4	·790	·3	·717	·2	·144
·6	·378	17·5	·882	·4	·826	·3	·272
·7	·458	·6	·977	20·5	·935	·4	·400
·8	·538	·7	15·072	·6	18·047	23·5	·528

TENSION OF AQUEOUS VAPOUR—*continued.*

°	mm.	°	mm.	°	mm.	°	mm.
+23·6	21·659	26·5	25·738	29·4	30·479	32·3	35·962
·7	·790	·6	·891	29·5	·654	·4	36·165
·8	·921	·7	26·045	·6	·833	32·5	·370
23·9	22·053	·8	·198	·7	31·011	·6	·576
24·0	22·184	26·9	·351	·8	·190	·7	·783
·1	·319	27·0	26·505	29·9	·369	·8	·991
·2	·453	·1	·663	30·0	31·548	32·9	37·200
·3	·588	·2	·820	·1	·729	33·0	37·410
·4	·723	·3	·978	·2	·911	·1	·621
24·5	·858	·4	27·136	·3	32·094	·2	·832
·6	·996	27·5	·294	·4	·278	·3	38·045
·7	23·135	·6	·455	30·5	·463	·4	·258
·8	·273	·7	·617	·6	·650	33·5	·473
·9	·411	·8	·778	·7	·837	·6	·689
25·0	23·550	27·9	·939	·8	33·026	·7	·906
·1	·692	28·0	28·101	30·9	·215	·8	39·124
·2	·834	·1	·267	31·0	33·405	33·9	·344
·3	·976	·2	·433	·1	·596	34·0	39·565
·4	24·119	·3	·599	·2	·787	·1	·786
25·5	·261	·4	·765	·3	·980	·2	40·007
·6	·406	28·5	28·931	·4	34·174	·3	·230
·7	·552	·6	29·101	31·5	·368	·4	·455
·8	·697	·7	·271	·6	·564	34·5	·680
25·9	·842	·8	·441	·7	·761	·6	·907
26·0	24·988	28·9	·612	·8	·959	·7	41·135
·1	25·138	29·0	29·782	31·9	35·159	·8	·364
·2	·288	·1	·956	32·0	35·359	34·9	·595
·3	·438	·2	30·131	·1	·559	35·0	·827
·4	·588	·3	·305	·2	·760		

TABLE SHOWING THE TENSION OF AQUEOUS VAPOUR IN MILLIMETRES OF MERCURY, FROM 30° C. TO 230° C.

Temp.	Tension.	Temp.	Tension.	Temp.	Tension.	Temp.	Tension.
−30	·39	21	18·5	94	610·4	105	907
−25	·61	22	19·7	94·5	622·2	107	972
−10	·9	23	20·9	95	633·8	110	1077
−15	1·4	24	22·7	95·5	645·7	115	1273
−10	2·1	25	23·6	96	657·5	120	1491
− 5	3·1	26	25·0	96·5	669·7	125	1744
− 2	4·0	27	26·6	97	682·0	130	2030
− 1	4·3	28	28·1	97·5	694·6	135	2354
0	4·6	29	29·8	98	707·3	140	2717
1	4·95	30	31·6	98·5	721·2	145	3125
2	5·3	35	41·9	99	732·2	150	3581
3	5·7	40	55·0	99·1	735·9	155	4088
4	6·1	45	71·5	99·2	738·5	160	4551
5	6·5	50	92·0	99·3	741·2	165	5274
6	7·0	55	117·5	99·4	743·8	170	5961
7	7·5	60	148·0	99·5	746·5	175	6717
8	8·0	65	186·0	99·6	749·2	180	7547
9	8·6	70	232·0	99·7	751·9	185	8453
10	9·1	75	287·0	99·8	754·6	190	9443
11	9·7	80	354·0	99·9	757·3	195	10520
12	10·4	85	432·0	100	760	200	11689
13	11·1	90	525·4	100·1	762·7	205	12956
14	11·9	90·5	535·5	100·2	765·5	210	14325
15	12·7	91	545·8	100·4	772·0	215	15801
16	13·5	91·5	556·2	100·6	776·5	220	17390
17	14·4	92	566·8	101	787·0	225	19097
18	15·3	92·5	577·3	102	816	230	20926
19	16·3	93	588·4	103	845	—	—
20	17·4	93·5	599·5	104	876	—	—

Degrees C ..	120	134	144	152	159	171	180	199	213	225
Atmospheres	2	3	4	5	6	8	10	15	20	25

TABLE SHOWING THE TENSION OF MERCURY VAPOUR.

° C.	Millim.	° C.	Millim.	° C.	Millim.	° C.	Millim.
0	·02	170	8·091	290	194·46	410	1864
”	”	180	11·000	300	242·15	420	2178
50	·113	190	14·84	310	299·69	430	2533
”	”	200	19·90	320	368·73	440	2934
90	·514	210	26·35	330	450·91	450	3384·35
100	·746	220	34·70	340	548·35	460	3888
110	1·073	230	45·35	350	663·18	470	4450
120	1·534	240	58·82	360	797·74	480	5062
130	2·175	250	75·75	370	954·65	490	5761
140	3·059	260	96·73	380	1195·65	500	6520·25
150	4·266	270	123·01	390	1346·71	510	7354
160	5·900	280	155·17	400	1587·96	520	8265

MULTIPLES OF THE COEFFICIENT OF DILATION (CUBICAL) OF ORDINARY GLASS.

T.	From 0° C. to 100° C.	From 0° C. to 150° C.	From 0° C. to 200° C.	From 0° C. to 250° C.	From 0° C. to 300° C.
1	·0000276	·0000284	·0000291	·0000298	·0000306
2	·0000552	·0000568	·0000582	·0000596	·0000612
3	·0000828	·0000852	·0000873	·0000894	·0000918
4	·0001104	·0001136	·0001164	·0001194	·0001224
5	·0001380	·0001420	·0001445	·0001490	·0001530
6	·0001656	·0001704	·0001746	·0001788	·0001836
7	·0001932	·0001988	·0002037	·0002086	·0002142
8	·0002208	·0002277	·0002328	·0002384	·0002448
9	·0002484	·0002556	·0002619	·0002682	·0002754

TABLE OF THE PROPERTIES OF SATURATED STEAM.

(Taken from 'Molesworth's Pocket-Book.')

Atmosphere included.		Temperature of Steam. F.	Specific Vol.	No. of Atmospheres.	Atmosphere excluded.	
Lbs. per Sq. In.	Inches of Mercury.				Inches of Mercury.	Lbs. per Sq. Inch.
1	2 0355	102·1	20582	·068	−27·886	−13·7
2	4·0701	126·3	10721	·136	−25·851	−12·7
3	6·1065	141·6	7322	·204	−23·815	−11·7
4	8·142	153·1	5583	·272	−21·780	−10·7
5	10·178	162·3	4527	·340	−19·744	− 9·7
6	12·213	170·2	3813	·408	−17·709	− 8·7
7	14·249	176·9	3298	·476	−15·673	− 7·7
8	16·284	182·9	2909	·544	−13·638	− 6·7
9	18·320	188·3	2604	·612	−11·602	− 5·7
10	20·355	193·3	2358	680	− 9·567	− 4·7
11	22·391	197·8	2157	·748	− 7·531	− 3·7
12	24·426	202·0	1986	·816	− 5·496	− 2·7
13	26·462	205·9	1842	·884	− 3·460	− 1·7
14	28·497	209·6	1720	·952	− 1·425	− 0·7
14·706	29·922	212·0	1642	1·000	∓ 0·000	∓ 0·0
15	30·533	213·1	1610	1·020	0·611	0·3
16	32·568	216·3	1515	1·088	2·646	1·3
17	34·604	219·6	1431	1·156	4·682	2·3
18	36·639	222·4	1357	1·224	6·717	3·3
19	38·675	225·3	1290	1·292	8·753	4·3
20	40·710	228·0	1229	1·360	10·788	5·3
21	42·746	230·6	1174	1·428	12·842	6·3
22	44·781	233·1	1123	1·496	14·859	7·3
23	46·817	235·5	1075	1·564	16·895	8·3
24	48·852	237·8	1036	1·632	18·930	9·3
25	50·888	240·1	996	1·700	20·966	10·3
30	61·065	250·4	838	2·040	31·143	15·3
35	71·243	259·3	726	2·380	41·321	20·3
40	81·420	267·3	640	2·720	51·498	25·3
45	91·598	274·4	572	3·060	61·676	30·3
50	101·776	281·0	518	3·400	71·854	35·3

TABLE OF THE PROPERTIES OF SATURATED STEAM—*continued.*

Atmosphere included.		Temperature of Steam. F.	Specific Vol.	No. of Atmospheres.	Atmosphere excluded.	
Lbs. per Sq. In.	Inches of Mercury.				Inches of Mercury.	Lbs. per Sq. Inch.
55	111·953	287·1	474	3·740	82·031	40·3
60	122·131	292·7	437	4·080	92·209	45·3
65	132·308	298·0	405	4·420	102·386	50·3
70	142·486	302·9	378	4·760	112·563	55·3
75	152·663	307·5	353	5·100	122·741	60·3
80	162·841	312·0	333	5·440	132·919	65·3
85	173·018	316·1	314	5·780	143·096	70·3
90	183·196	320·2	298	6·120	153·274	75·3
95	193·373	324·1	283	6·460	163·451	80·3
100	203·551	327·9	270	6·800	173·629	85·3
110	223·906	334·6	247	7·480	193·984	95·3
120	244·261	341·1	227	8·160	214·339	105·3
130	264·616	347·2	211	8·840	234·694	115·3
140	284·971	352·9	197	9·520	255·049	125·3
150	305·327	358·3	184	10·200	275·405	135·3
160	325·682	363·4	174	10·880	295·760	145·3
170	346·037	368·2	164	11·560	316·115	155·3
180	366·392	372·9	155	12·240	336·470	165·3
190	386·747	377·5	148	12·920	356·825	175·3
200	407·102	381·7	141	13·600	377·180	185·3
250	508·878	401·1	114	17·000	478·956	235·3
300	610·653	417·5	96	20·400	580·731	285·3
350	712·429	430·1	83	23·800	682·507	335·3
400	814·204	444·9	73	27·200	784·282	385·3
450	915·980	456·7	66	30·600	886·058	435·3
500	1017·755	467·5	59	34·000	987·833	485·3
600	1221·306	487·0	50	40·800	1191·384	585·3
700	1424·857	504·1	43	47·600	1394·935	685·3
800	1628·408	519·5	38	54·400	1598·486	785·3
900	1831·959	533·6	34	61·200	1802·037	885·3
1000	2035·510	546·5	31	68·000	2005·588	985·3

TRANSFORMATION OF COLUMNS OF WATER (WATER PRESSURE) INTO COLUMNS OF MERCURY (MERCURY PRESSURE) IN MILLIMETERS.

Aq.	Hg.	Aq.	Hg.	Aq.	Hg.	Aq.	Hg.	Aq.	Hg.	Aq.	Hg.	Aq.	Hg.	Aq.	Hg
1	0·07	15	1·12	29	2·14	43	3·17	57	4·21	71	5·24	85	6·27	99	7·31
2	0·15	16	1·18	30	2·21	44	3·25	58	4·28	72	5·31	86	6·35	100	7·38
3	0·22	17	1·26	31	2·29	45	3·32	59	4·35	73	5·39	87	6·42	200	14·76
4	0·30	18	1·33	32	2·36	46	3·39	60	4·43	74	5·46	88	6·49	300	22·14
5	0·37	19	1·40	33	2·44	47	3·47	61	4·50	75	5·54	89	6·57	400	29·52
6	0·44	20	1·48	34	2·51	48	3·54	62	4·58	76	5·61	90	6·64	500	36·90
7	0·52	21	1·55	35	2·58	49	3·62	63	4·65	77	5·68	91	6·72	600	44·28
8	0·59	22	1·62	36	2·66	50	3·69	64	4·72	78	5·76	92	6·79	700	51·66
9	0·66	23	1·70	37	2·73	51	3·76	65	4·80	79	5·83	93	6·86	800	59·04
10	0·74	24	1·77	38	2·80	52	3·84	66	4·87	80	5·90	94	6·94	900	66·42
11	0·81	25	1·84	39	2·88	53	3·91	67	4·94	81	5·98	95	7·01	1000	73·80
12	0·89	26	1·92	40	2·95	54	3·99	68	5·02	82	6·05	96	7·08	2000	147·6
13	0·96	27	1·98	41	3·03	55	4·06	69	5·09	83	6·13	97	7·16		
14	1·03	28	2·07	42	3·10	56	4·13	70	5·17	84	6·20	98	7·23	5000	369·0

KOPP'S TABLE, SHOWING THE EXPANSION OF WATER FROM 0° C. TO 100° C. (32° F. TO 212° F.).

Temp. Cent.	Temp. Fahr.	Volume.	Temp. Cent.	Temp. Fahr.	Volume.
0°	32	1·000000	21°	69·8	1·001776
1	33·8	·999947	22	71·6	1·001995
2	35·6	·999908	23	73·4	1·002225
3	37·4	·999885	24	75·2	1·002465
4	39·2	·999877	25	77·0	1·002715
5	41·0	·999883	30	86·0	1·004064
6	42·8	·999903	35	95·0	1·005697
7	44·6	·999938	40	104·0	1·007531
8	46·4	·999986	45	113·0	1·009541
9	48·2	1·000048	50	122·0	1·011766
10	50·0	1·000124	55	131·0	1·014100
11	51·8	1·000213	60	140·0	1·016590
12	53·6	1·000314	65	149·0	1·019302
13	55·4	1·000429	70	158·0	1·022246
14	57·2	1·000556	75	167·0	1·025440
15	59·0	1·000695	80	176·0	1·028581
16	60·8	1·000846	85	185·0	1·031894
17	62·6	1·001010	90	194·0	1·035397
18	64·4	1·001184	95	203·0	1·039094
19	66·2	1·001370	100	212·0	1·042986
20	68·0	1·001567			

TABLE SHOWING THE DENSITY OF WATER AT ORDINARY TEMPERATURE.

Temp.	Density.	Temp.	Density.	Temp.	Density.
0° C.	·999871	11° C.	·999655	22° C.	·997826
1	·999928	12	·999549	23	·997601
2	·999969	13	·999430	24	·997367
3	·999991	14	·999299	25	·997120
4	1·000000	15	·999160	26	·996866
5	·999990	16	·999002	27	·996603
6	·999970	17	·998841	28	·996331
7	·999933	18	·998654	29	·996051
8	·999886	19	·998460	30	·995765
9	·999824	20	·998259	100	·958650
10	·999747	21	·998047		

WEIGHT OF ONE C. C. OF AIR AT DIFFERENT TEMPERATURES, FROM 0° C. TO 300° C. AT 760 MM.

Temp. C.	Grams.	Temp. C.	Grams.	Temp. C.	Grams.	Temp. C.	Grams.
0	·001293	38	·001134	76	·001011	114	·000911
1	·001288	39	·001131	77	·001008	115	·000909
2	·001284	40	·001128	78	·001005	116	·000907
3	·001279	41	·001124	79	·001002	117	·000905
4	·001275	42	·001121	80	·001000	118	·000903
5	·001270	43	·001118	81	·000997	119	·000900
6	·001266	44	·001114	82	·000994	120	·000898
7	·001261	45	·001111	83	·000992	121	·000896
8	·001257	46	·001108	84	·000989	122	·000894
9	·001252	47	·001105	85	·000986	123	·000891
10	·001248	48	·001102	86	·000983	124	·000889
11	·001243	49	·001098	87	·000980	125	·000887
12	·001239	50	·001095	88	·000977	126	·000884
13	·001234	51	·001091	89	·000974	127	·000882
14	·001230	52	·001088	90	·000972	128	·000880
15	·001225	53	·001084	91	·000969	129	·000878
16	·001221	54	·001081	92	·000967	130	·000876
17	·001217	55	·001077	93	·000964	131	·000874
18	·001213	56	·001074	94	·000962	132	·000871
19	·001209	57	·001070	95	·000959	133	·000869
20	·001205	58	·001067	96	·000956	134	·000867
21	·001201	59	·001063	97	·000953	135	·000865
22	·001197	60	·001060	98	·000951	136	·000863
23	·001193	61	·001057	99	·000948	137	·000860
24	·001189	62	·001053	100	·000946	138	·000858
25	·001185	63	·001050	101	·000943	139	·000856
26	·001181	64	·001047	102	·000941	140	·000854
27	·001177	65	·001044	103	·000938	141	·000852
28	·001173	66	·001041	104	·000936	142	·000850
29	·001169	67	·001038	105	·000933	143	·000848
30	001165	68	·001035	106	·000931	144	·000846
31	·001161	69	·001032	107	·000928	145	·000844
32	·001157	70	·001029	108	·000926	146	·000842
33	·001154	71	·001026	109	·000923	147	·000840
34	·001150	72	·001023	110	·000921	148	·000838
35	·001146	73	·001020	111	·000919	149	·000836
36	·001142	74	·001017	112	·000916	150	·000834
37	·001138	75	·001014	113	·000914	151	·000832

WEIGHT OF ONE C. C. OF AIR, &C.—*continued.*

Temp. C.	Grams.	Temp. C.	Grams.	Temp. C.	Grams.	Temp. C.	Grams.
152	·000830	190	·000762	227	·000705	264	·000657
153	·000828	191	·000760	228	·000703	265	·000655
154	·000826	192	·000758	229	·000702	266	·000654
155	·000824	193	·000757	230	·000701	267	·000653
156	·000822	194	·000755	231	·000699	268	·000652
157	·000821	195	·000754	232	·000698	269	·000651
158	·000819	196	·000752	233	·000697	270	·000650
159	·000817	197	·000751	234	·000695	271	·000648
160	·000815	198	·000749	235	·000694	272	·000646
161	·000813	199	·000748	236	·000692	273	·000645
162	·000811	200	·000746	237	·000691	274	·000644
163	·000809	201	·000744	238	·000690	275	·000643
164	·000807	202	·000743	239	·000689	276	·000642
165	·000806	203	·000740	240	·000688	277	·000641
166	·000804	204	·000739	241	·000686	278	·000640
167	·000802	205	·000737	242	·000685	279	·000639
168	·000800	206	·000736	243	·000683	280	·000638
169	·000798	207	·000734	244	·000682	281	·000636
170	·000796	208	·000733	245	·000681	282	·000635
171	·000794	209	·000731	246	·000679	283	·000634
172	·000793	210	·000730	247	·000678	284	·000633
173	·000791	211	·000728	248	·000677	285	·000631
174	·000789	212	·000727	249	·000675	286	·000630
175	·000788	213	·000725	250	·000674	287	·000629
176	·000786	214	·000724	251	·000673	288	·000628
177	·000784	215	·000722	252	·000672	289	·000627
178	·000782	216	·000721	253	·000670	290	·000626
179	·000781	217	·000719	254	·000669	291	·000625
180	·000779	218	·000718	255	·000668	292	·000624
181	·000777	219	·000716	256	·000666	293	·000623
182	·000776	220	·000715	257	·000665	294	·000622
183	·000774	221	·000713	258	·000664	295	·000621
184	·000772	222	·000712	259	·000663	296	·000620
185	·000770	223	·000710	260	·000662	297	·000619
186	·000769	224	·000709	261	·000660	298	·000618
187	·000767	225	·000708	262	·000659	299	·000617
188	·000765	226	·000706	263	·000658	300	·000616
189	·000763						

REDUCTION OF CUBIC CENTIMETRES OF NITROGEN TO GRAMS.

$$\text{Log.}\ \frac{0\cdot0012562}{(1+\cdot00367\,t)\,760}$$

for each tenth of a degree from 0° to 30° C.

t C.	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
°										
0	$\bar{6}$·21824	808	793	777	761	745	729	713	697	681
1	665	649	633	617	601	586	570	554	538	522
2	507	491	475	459	443	427	412	396	380	364
3	349	333	318	302	286	270	255	239	223	208
4	192	177	161	145	130	114	098	083	067	051
5	035	020	004	*989	*973	*957	*942	*926	*911	*895
6	$\bar{6}$·20879	864	848	833	817	801	786	770	755	739
7	723	708	692	676	661	645	629	614	598	583
8	567	552	536	521	505	490	427	459	443	428

REDUCTION OF CUBIC CENTIMETRES, &c.—*continued.*

t C.	0·0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
°										
9	413	397	382	366	351	335	320	304	289	274
10	259	244	228	213	198	182	167	151	136	121
11	106	090	075	060	045	029	014	*999	*984	*969
12	$\bar{6}$·19953	938	923	907	892	877	862	846	831	816
13	800	785	770	755	740	724	709	694	679	664
14	648	633	618	603	588	573	558	543	528	513
15	497	482	467	452	437	422	407	392	377	362
16	346	331	316	301	286	271	256	241	226	211
17	196	181	166	157	136	121	106	091	076	061
18	046	031	016	001	*986	*971	*956	*941	*926	*911
19	$\bar{6}$·18897	882	867	852	837	822	807	792	777	762
20	748	733	718	703	688	673	659	644	629	614
21	600	585	570	555	540	526	511	496	481	466
22	452	437	422	408	393	378	363	349	334	319
23	305	290	275	261	246	231	216	202	187	172
24	158	143	128	114	099	084	070	055	041	026
25	012	*997	*982	*968	*953	*938	*924	*909	*895	*880
26	$\bar{6}$·17866	851	837	822	808	793	779	764	750	735
27	721	706	692	677	663	648	634	619	605	590
28	576	561	547	532	518	503	489	475	460	446
29	432	417	403	388	374	360	345	331	316	302

Table showing the Weight of 1 cm.^{3} of Nitrogen (Mgs.) at Various Temperatures and Pressures.

° F.	° C.	726 mm. 28·58 in.	727 mm. 28·62 in.	728 mm. 28·66 in.	729 mm. 28·70 in.	730 mm. 28·74 in.
32	0	1·1927	1·1944	1·1960	1·1977	1·1993
33·8	1	1·1879	1·1895	1·1912	1·1928	1·1945
35·6	2	1·1829	1·1846	1·1862	1·1879	1·1895
37·4	3	1·1781	1·1797	1·1814	1·1830	1·1846
39·2	4	1·1731	1·1748	1·1764	1·1780	1·1797
41	5	1·1682	1·1698	1·1714	1·1731	1·1747
42·8	6	1·1632	1·1649	1·1665	1·1681	1·1697
44·6	7	1·1583	1·1599	1·1615	1·1631	1·1647
46·4	8	1·1533	1·1549	1·1566	1·1582	1·1598
48·2	9	1·1484	1·1500	1·1516	1·1532	1·1548
50	10	1·1433	1·1449	1·1465	1·1481	1·1497
51·8	11	1·1384	1·1400	1·1416	1·1432	1·1448
53·6	12	1·1332	1·1348	1·1364	1·1381	1·1396
55·4	13	1·1282	1·1298	1·1314	1·1329	1·1445
57·2	14	1·1231	1·1247	1·1263	1·1279	1·1294
59	15	1·1180	1·1196	1·1211	1·1227	1·1243
60·8	16	1·1128	1·1144	1·1160	1·1175	1·1191
62·6	17	1·1077	1·1092	1·1108	1·1124	1·1139
64·4	18	1·1023	1·1039	1·1054	1·1070	1·1085
66·2	19	1·0971	1·0986	1·1002	1·1017	1·1033
68	20	1·0917	1·0933	1·0948	1·0964	1·0979
69·8	21	1·0863	1·0878	1·0894	1·0900	1·0924
71·6	22	1·0808	1·0824	1·0839	1·0854	1·0869
73·4	23	1·0753	1·0768	1·0783	1·0799	1·0814
75·2	24	1·0697	1·0712	1·0728	1·0743	1·0758
77	25	1·0640	1·0655	1·0670	1·0685	1·0700
78·8	26	1·0583	1·0598	1·0613	1·0628	1·0644
80·6	27	1·0526	1·0541	1·0556	1·0571	1·0586
82·4	28	1·0467	1·0482	1·0497	1·0512	1·0527
84·2	29	1·0406	1·0421	1·0436	1·0451	1·0466
86	30	1·0317	1·0362	1·0377	1·0392	1·0407
87·8	31	1·0285	1·0300	1·0315	1·0329	1·0344
89·6	32	1·0222	1·0237	1·0251	1·0266	1·0281
91·4	33	1·0159	1·0174	1·0188	1·0203	1·0218
93·2	34	1·0093	1·0107	1·0122	1·0137	1·0152
95	35	1·0028	1·0042	1·0057	1·0072	1·0086

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	731 mm. 28·78 in.	732 mm. 28·82 in.	733 mm. 28·82 in.	734 mm. 28·90 in.	735 mm. 28·94 in.
32	0	1·2010	1·2026	1·2043	1·2059	1·2076
33·8	1	1·1961	1·1978	1·1994	1·2011	1·2027
35·6	2	1·1911	1·1928	1·1944	1·1961	1·1977
37·4	3	1·1863	1·1879	1·1895	1·1912	1·1928
39·2	4	1·1813	1·1829	1·1845	1·1862	1·1878
41	5	1·1763	1·1779	1·1796	1·1812	1·1828
42·8	6	1·1713	1·1729	1·1746	1·1762	1·1778
44·6	7	1·1664	1·1680	1·1696	1·1712	1·1728
46·4	8	1·1614	1·1630	1·1646	1·1662	1·1678
48·2	9	1·1564	1·1580	1·1596	1·1612	1·1628
50	10	1·1513	1·1529	1·1545	1·1561	1·1577
51·8	11	1·1463	1·1479	1·1495	1·1511	1·1527
53·6	12	1·1412	1·1427	1·1443	1·1459	1·1475
55·4	13	1·1361	1·1377	1·1392	1·1408	1·1424
57·2	14	1·1310	1·1326	1·1342	1·1357	1·1373
59	15	1·1258	1·1274	1·1290	1·1305	1·1321
60·8	16	1·1207	1·1222	1·1238	1·1253	1·1269
62·6	17	1·1155	1·1170	1·1186	1·1201	1·1217
64·4	18	1·1101	1·1116	1·1132	1·1147	1·1163
66·2	19	1·1048	1·1064	1·1079	1·1095	1·1110
68	20	1·0994	1·1010	1·1025	1·1041	1·1056
69·8	21	1·0940	1·0955	1·0970	1·0986	1·1001
71·6	22	1·0885	1·0900	1·0915	1·0931	1·0946
73·4	23	1·0829	1·0844	1·0860	1·0875	1·0890
75·2	24	1·0773	1·0788	1·0804	1·0819	1·0834
77	25	1·0715	1·0731	1·0746	1·0761	1·0776
78·8	26	1·0659	1·0674	1·0689	1·0704	1·0719
80·6	27	1·0601	1·0616	1·0631	1·0646	1·0661
82·4	28	1·0542	1·0557	1·0572	1·0587	1·0602
84·2	29	1·0481	1·0496	1·0511	1·0526	1·0541
86	30	1·0421	1·0436	1·0451	1·0466	1·0481
87·8	31	1·0359	1·0374	1·0389	1·0404	1·0419
89·6	32	1·0296	1·0311	1·0325	1·0340	1·0355
91·4	33	1·0233	1·0247	1·0262	1·0277	1·0292
93·2	34	1·0166	1·0181	1·0196	1·0210	1·0225
95	35	1·0101	1·0116	1·0130	1·0145	1·0160

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	736 mm. 28·98 in.	737 mm. 29·02 in.	738 mm. 29·06 in.	739 mm. 29·09 in.	740 mm. 29·13 in.
32	0	1·2092	1·2109	1·2125	1·2142	1·2158
33·8	1	1·2043	1·2060	1·2076	1·2093	1·2109
35·6	2	1·1993	1·2010	1·2026	1·2043	1·2059
37·4	3	1·1944	1·1961	1·1977	1·1993	1·2010
39·2	4	1·1894	1·1911	1·1927	1·1943	1·1959
41	5	1·1844	1·1860	1·1877	1·1893	1·1909
42·8	6	1·1794	1·1810	1·1827	1·1843	1·1859
44·6	7	1·1744	1·1760	1·1776	1·1792	1·1809
46·4	8	1·1694	1·1710	1·1726	1·1742	1·1758
48·2	9	1·1644	1·1660	1·1676	1·1692	1·1708
50	10	1·1593	1·1609	1·1625	1·1641	1·1657
51·8	11	1·1543	1·1559	1·1575	1·1591	1·1606
53·6	12	1·1491	1·1507	1·1523	1·1538	1·1554
55·4	13	1·1440	1·1456	1·1471	1·1487	1·1503
57·2	14	1·1389	1·1404	1·1420	1·1436	1·1452
59	15	1·1337	1·1352	1·1368	1·1384	1·1399
60·8	16	1·1285	1·1300	1·1316	1·1331	1·1347
62·6	17	1·1233	1·1248	1·1264	1·1279	1·1295
64·4	18	1·1179	1·1194	1·1210	1·1225	1·1241
66·2	19	1·1125	1·1141	1·1156	1·1172	1·1187
68	20	1·1071	1·1087	1·1102	1·1118	1·1133
69·8	21	1·1016	1·1032	1·1047	1·1062	1·1078
71·6	22	1·0961	1·0977	1·0992	1·1007	1·1023
73·4	23	1·0905	1·0921	1·0936	1·0951	1·0966
75·2	24	1·0849	1·0864	1·0880	1·0895	1·0910
77	25	1·0791	1·0806	1·0821	1·0837	1·0852
78·8	26	1·0734	1·0749	1·0764	1·0779	1·0794
80·6	27	1·0676	1·0691	1·0706	1·0721	1·0736
82·4	28	1·0617	1·0632	1·0647	1·0662	1·0677
84·2	29	1·0556	1·0571	1·0586	1·0601	1·0616
86	30	1·0496	1·0511	1·0526	1·0541	1·0555
87·8	31	1·0433	1·0448	1·0463	1·0478	1·0493
89·6	32	1·0370	1·0385	1·0399	1·0414	1·0429
91·4	33	1·0306	1·0321	1·0336	1·0351	1·0365
93·2	34	1·0240	1·0254	1·0269	1·0284	1·0299
95	35	1·0174	1·0189	1·0204	1·0218	1·0233

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	741 mm. 29·17 in.	742 mm. 29·21 in.	743 mm. 29·25 in.	744 mm. 29·29 in.	745 mm. 29·33 in.
32	0	1·2175	1·2912	1·2208	1·2225	1·2241
33·8	1	1·2126	1·2142	1·2159	1·2175	1·2192
35·6	2	1·2075	1·2092	1·2108	1·2125	1·2141
37·4	3	1·2025	1·2041	1·2058	1·2074	1·2090
39·2	4	1·1976	1·1992	1·2008	1·2025	1·2041
41	5	1·1925	1·1942	1·1958	1·1974	1·1990
42·8	6	1·1875	1·1891	1·1907	1·1924	1·1940
44·6	7	1·1825	1·1841	1·1857	1·1873	1·1889
46·4	8	1·1774	1·1790	1·1807	1·1823	1·1839
48·2	9	1·1724	1·1740	1·1756	1·1772	1·1788
50	10	1·1673	1·1689	1·1705	1·1721	1·1737
51·8	11	1·1622	1·1638	1·1654	1·1670	1·1686
53·6	12	1·1570	1·1586	1·1602	1·1618	1·1633
55·4	13	1·1519	1·1534	1·1550	1·1566	1·1582
57·2	14	1·1467	1·1483	1·1499	1·1515	1·1530
59	15	1·1415	1·1431	1·1446	1·1462	1·1478
60·8	16	1·1363	1·1378	1·1394	1·1410	1·1425
62·6	17	1·1310	1·1326	1·1342	1·1357	1·1373
64·4	18	1·1256	1·1272	1·1287	1·1303	1·1318
66·2	19	1·1203	1·1218	1·1234	1·1249	1·1265
68	20	1·1148	1·1164	1·1179	1·1195	1·1210
69·8	21	1·1093	1·1108	1·1124	1·1139	1·1155
71·6	22	1·1038	1·1053	1·1068	1·1084	1·1099
73·4	23	1·0982	1·0997	1·1012	1·1027	1·1043
75·2	24	1·0925	1·0940	1·0956	1·0971	1·0986
77	25	1·0867	1·0882	1·0897	1·0912	1·0927
78·8	26	1·0810	1·0825	1·0840	1·0855	1·0870
80·6	27	1·0751	1·0766	1·0781	1·0796	1·0811
82·4	28	1·0692	1·0707	1·0722	1·0737	1·0752
84·2	29	1·0631	1·0646	1·0661	1·0676	1·0690
86	30	1·0570	1·0585	1·0600	1·0615	1·0630
87·8	31	1·0508	1·0522	1·0537	1·0552	1·0567
89·6	32	1·0444	1·0459	1·0473	1·0488	1·0503
91·4	33	1·0380	1·0395	1·0410	1·0424	1·0439
93·2	34	1·0313	1·0328	1·0343	1·0357	1·0372
95	35	1·0248	1·0262	1·0277	1·0291	1·0306

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	746 mm. 29·37 in.	747 mm. 29·41 in.	748 mm. 29·45 in.	749 mm. 29·49 in.	750 mm. 29·53 in.
32	0	1·2258	1·2274	1·2291	1·2307	1·2324
33·8	1	1·2208	1·2225	1·2241	1·2258	1·2274
35·6	2	1·2158	1·2174	1·2190	1·2207	1·2223
37·4	3	1·2107	1·2123	1·2140	1·2156	1·2172
39·2	4	1·2057	1·2074	1·2090	1·2106	1·2122
41	5	1·2007	1·2023	1·2039	1·2055	1·2072
42·8	6	1·1956	1·1972	1·1988	1·2005	1·2021
44·6	7	1·1905	1·1921	1·1938	1·1954	1·1970
46·4	8	1·1855	1·1871	1·1887	1·1903	1·1919
48·2	9	1·1804	1·1820	1·1836	1·1852	1·1868
50	10	1·1753	1·1769	1·1784	1·1800	1·1816
51·8	11	1·1702	1·1718	1·1734	1·1750	1·1765
53·6	12	1·1649	1·1665	1·1681	1·1697	1·1713
55·4	13	1·1598	1·1613	1·1629	1·1645	1·1661
57·2	14	1·1546	1·1562	1·1577	1·1593	1·1609
59	15	1·1493	1·1509	1·1525	1·1540	1·1556
60·8	16	1·1441	1·1456	1·1472	1·1488	1·1503
62·6	17	1·1388	1·1404	1·1419	1·1435	1·1450
64·4	18	1·1334	1·1349	1·1365	1·1380	1·1396
66·2	19	1·1280	1·1296	1·1311	1·1326	1·1342
68	20	1·1225	1·1241	1·1256	1·1272	1·1287
69·8	21	1·1170	1·1185	1·1201	1·1216	1·1231
71·6	22	1·1114	1·1130	1·1145	1·1160	1·1176
73·4	23	1·1058	1·1073	1·1088	1·1103	1·1119
75·2	24	1·1001	1·1016	1·1032	1·1047	1·1062
77	25	1·0943	1·0058	1·0973	1·0988	1·1003
78·8	26	1·0885	1·0900	1·0915	1·0930	1·0945
80·6	27	1·0827	1·0842	1·0857	1·0872	1·0887
82·4	28	1·0767	1·0782	1·0797	1·0812	1·0827
84·2	29	1·0705	1·0720	1·0735	1·0750	1·0765
86	30	1·0645	1·0660	1·0675	1·0690	1·0704
87·8	31	1·0582	1·0597	1·0612	1·0626	1·0641
89·6	32	1·0518	1·0533	1·0547	1·0562	1·0577
91·4	33	1·0454	1·0469	1·0483	1·0498	1·0513
93·2	34	1·0387	1·0401	1·0416	1·0431	1·0446
95	35	1·0321	1·0335	1·0350	1·0365	1·0379

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	751 mm. 29·57 in.	752 mm. 29·61 in.	753 mm. 29·65 in.	754 mm. 29·69 in.	755 mm 29·72 in.
32	0	1·2340	1·2357	1·2373	1·2390	1·2406
33·8	1	1·2291	1·2307	1·2324	1·2340	1·2356
35·6	2	1·2240	1·2256	1·2272	1·2289	1·2305
37·4	3	1·2189	1·2205	1·2221	1·2238	1·2254
39·2	4	1·2139	1·2155	1·2171	1·2188	1·2204
41	5	1·2088	1·2104	1·2120	1·2137	1·2153
42·8	6	1·2037	1·2053	1·2069	1·2085	1·2102
44·6	7	1·1986	1·2002	1·2018	1·2034	1·2051
46·4	8	1·1935	1·1951	1·1967	1·1983	1·1999
48·2	9	1·1884	1·1900	1·1916	1·1932	1·1948
50	10	1·1832	1·1848	1·1864	1·1880	1·1896
51·8	11	1·1781	1·1797	1·1813	1·1829	1·1845
53·6	12	1·1728	1·1744	1·1760	1·1776	1·1792
55·4	13	1·1677	1·1692	1·1708	1·1724	1·1740
57·2	14	1·1625	1·1640	1·1656	1·1672	1·1687
59	15	1·1572	1·1587	1·1603	1·1619	1·1634
60·8	16	1·1519	1·1535	1·1550	1·1566	1·1581
62·6	17	1·1466	1·1482	1·1497	1·1513	1·1528
64·4	18	1·1411	1·1427	1·1442	1·1458	1·1473
66·2	19	1·1357	1·1373	1·1388	1·1404	1·1419
68	20	1·1303	1·1318	1·1333	1·1349	1·1364
69·8	21	1·1247	1·1262	1·1277	1·1293	1·1308
71·6	22	1·1191	1·1206	1·1221	1·1237	1·1252
73·4	23	1·1134	1·1149	1·1164	1·1180	1·1195
75·2	24	1·1077	1·1092	1·1108	1·1123	1·1138
77	25	1·1018	1·1034	1·1049	1·1064	1·1079
78·8	26	1·0961	1·0976	1·0991	1·1006	1·1021
80·6	27	1·0902	1·0917	1·0932	1·0947	1·0962
82·4	28	1·0842	1·0857	1·0872	1·0887	1·0902
84·2	29	1·0780	1·0795	1·0810	1·0825	1·0840
86	30	1·0719	1·0734	1·0749	1·0764	1·0779
87·8	31	1·0656	1·0671	1·0686	1·0701	1·0716
89·6	32	1·0592	1·0607	1·0621	1·0636	1·0651
91·4	33	1·0528	1·0542	1·0557	1·0572	1·0587
93·2	34	1·0460	1·0475	1·0490	1·0505	1·0519
95	35	1·0394	1·0409	1·0423	1·0438	1·0453

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	756 mm. 29·76 in.	757 mm. 29·80 in.	758 mm. 29·84 in.	759 mm. 29·88 in.	760 mm. 29·92 in.
32	0	1·2423	1·2440	1·2456	1·2473	1·2489
33·8	1	1·2373	1·2389	1·2406	1·2422	1·2439
35·6	2	1·2322	1·2338	1·2355	1·2371	1·2387
37·4	3	1·2270	1·2287	1·2303	1·2320	1·2336
39·2	4	1·2220	1·2237	1·2253	1·2269	1·2285
41	5	1·2169	1·2185	1·2202	1·2218	1·2234
42·8	6	1·2118	1·2134	1·2150	1·2166	1·2182
44·6	7	1·2067	1·2083	1·2099	1·2115	1·2131
46·4	8	1·2015	1·2031	1·2047	1·2064	1·2080
48·2	9	1·1964	1·1980	1·1996	1·2012	1·2028
50	10	1·1912	1·1928	1·1944	1·1960	1·1976
51·8	11	1·1861	1·1877	1·1893	1·1909	1·1924
53·6	12	1·1808	1·1823	1·1839	1·1855	1·1871
55·4	13	1·1755	1·1771	1·1787	1·1803	1·1819
57·2	14	1·1703	1·1719	1·1735	1·1750	1·1766
59	15	1·1650	1·1666	1·1681	1·1697	1·1713
60·8	16	1·1597	1·1613	1·1628	1·1614	1·1660
62·6	17	1·1544	1·1559	1·1575	1·1591	1·1606
64·4	18	1·1489	1·1504	1·1520	1·1535	1·1551
66·2	19	1·1435	1·1450	1·1466	1·1481	1·1496
68	20	1·1380	1·1395	1·1410	1·1426	1·1441
69·8	21	1·1323	1·1339	1·1354	1·1369	1·1385
71·6	22	1·1267	1·1283	1·1298	1·1313	1·1329
73·4	23	1·1210	1·1225	1·1241	1·1256	1·1271
75·2	24	1·1153	1·1168	1·1184	1·1199	1·1214
77	25	1·1094	1·1109	1·1124	1·1140	1·1155
78·8	26	1·1036	1·1051	1·1066	1·1081	1·1096
80·6	27	1·0977	1·0992	1·1007	1·1022	1·1037
82·4	28	1·0917	1·0932	1·0947	1·0962	1·0977
84·2	29	1·0855	1·0870	1·0885	1·0900	1·0915
86	30	1·0794	1·0809	1·0824	1·0839	1·0853
87·8	31	1·0730	1·0745	1·0760	1·0775	1·0790
89·6	32	1·0666	1·0681	1·0695	1·0710	1·0725
91·4	33	1·0601	1·0616	1·0631	1·0646	1·0660
93·2	34	1·0534	1·0549	1·0563	1·0578	1·0593
95	35	1·0467	1·0482	1·0497	1·0511	1·0526

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	761 mm. 29·96 in.	762 mm. 30·00 in.	763 mm. 30·04 in.	764 mm. 30·08 in.	765 mm. 30·12 in.
32	0	1·2506	1·2522	1·2539	1·2555	1·2572
33·8	1	1·2455	1·2472	1·2488	1·2505	1·2521
35·6	2	1·2404	1·2420	1·2437	1·2453	1·2469
37·4	3	1·2352	1·2369	1·2385	1·2401	1·2418
39·2	4	1·2302	1·2318	1·2334	1·2351	1·2367
41	5	1·2250	1·2267	1·2283	1·2299	1·2315
42·8	6	1·2199	1·2215	1·2231	1·2247	1·2263
44·6	7	1·2147	1·2163	1·2179	1·2196	1·2212
46·4	8	1·2096	1·2112	1·2128	1·2144	1·2160
48·2	9	1·2044	1·2060	1·2076	1·2092	1·2108
50	10	1·1992	1·2008	1·2024	1·2040	1·2056
51·8	11	1·1940	1·1956	1·1972	1·1988	1·2004
53·6	12	1·1887	1·1903	1·1918	1·1934	1·1950
55·4	13	1·1834	1·1850	1·1866	1·1882	1·1897
57·2	14	1·1782	1·1798	1·1813	1·1829	1·1845
59	15	1·1729	1·1744	1·1760	1·1776	1·1791
60·8	16	1·1675	1·1691	1·1706	1·1722	1·1738
62·6	17	1·1622	1·1637	1·1653	1·1668	1·1684
64·4	18	1·1566	1·1582	1·1597	1·1613	1·1628
66·2	19	1·1512	1·1527	1·1543	1·1558	1·1574
68	20	1·1457	1·1472	1·1487	1·1503	1·1518
69·8	21	1·1400	1·1416	1·1431	1·1446	1·1462
71·6	22	1·1344	1·1359	1·1374	1·1390	1·1405
73·4	23	1·1286	1·1302	1·1317	1·1332	1·1347
75·2	24	1·1229	1·1244	1·1260	1·1275	1·1290
77	25	1·1170	1·1185	1·1200	1·1215	1·1230
78·8	26	1·1112	1·1127	1·1142	1·1157	1·1172
80·6	27	1·1052	1·1067	1·1082	1·1097	1·1112
82·4	28	1·0992	1·1007	1·1022	1·1037	1·1052
84·2	29	1·0930	1·0945	1·0960	1·0974	1·0989
86	30	1·0868	1·0883	1·0898	1·0913	1·0928
87·8	31	1·0805	1·0819	1·0834	1·0849	1·0864
89·6	32	1·0740	1·0755	1·0769	1·0784	1·0799
91·4	33	1·0675	1·0690	1·0705	1·0719	1·0734
93·2	34	1·0607	1·0622	1·0637	1·0652	1·0666
95	35	1·0541	1·0555	1·0570	1·0585	1·0599

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF NITROGEN (MGS.) AT VARIOUS TEMPERATURES AND PRESSURES—*contd.*

° F.	° C.	766 mm. 30·16 in.	767 mm. 30·20 in.	768 mm. 30·24 in.	769 mm. 30·28 in.	770 mm. 30·32 in.
32	0	1·2588	1·2605	1·2621	1·2638	1·2654
33·8	1	1·2538	1·2554	1·2571	1·2587	1·2604
35·6	2	1·2486	1·2502	1·2519	1·2535	1·2551
37·4	3	1·2434	1·2450	1·2467	1·2483	1·2499
39·2	4	1·2383	1·2399	1·2416	1·2432	1·2448
41	5	1·2332	1·2348	1·2364	1·2380	1·2397
42·8	6	1·2279	1·2296	1·2312	1·2328	1·2344
44·6	7	1·2228	1·2244	1·2260	1·2276	1·2292
46·4	8	1·2176	1·2192	1·2208	1·2224	1·2240
48·2	9	1·2124	1·2140	1·2156	1·2172	1·2188
50	10	1·2072	1·2088	1·2103	1·2119	1·2135
51·8	11	1·2020	1·2036	1·2052	1·2067	1·2083
53·6	12	1·1966	1·1982	1·1998	1·2013	1·2029
55·4	13	1·1913	1·1929	1·1945	1·1961	1·1976
57·2	14	1·1860	1·1876	1·1892	1·1908	1·1923
59	15	1·1807	1·1823	1·1838	1·1854	1·1870
60·8	16	1·1753	1·1769	1·1784	1·1800	1·1816
62·6	17	1·1700	1·1715	1·1731	1·1746	1·1762
64·4	18	1·1644	1·1659	1·1675	1·1690	1·1706
66·2	19	1·1589	1·1605	1·1620	1·1636	1·1651
68	20	1·1534	1·1549	1·1564	1·1580	1·1595
69·8	21	1·1477	1·1492	1·1508	1·1523	1·1538
71·6	22	1·1420	1·1436	1·1451	1·1466	1·1482
73·4	23	1·1363	1·1378	1·1393	1·1408	1·1424
75·2	24	1·1305	1·1320	1·1336	1·1351	1·1366
77	25	1·1246	1·1261	1·1276	1·1291	1·1306
78·8	26	1·1187	1·1202	1·1217	1·1232	1·1247
80·6	27	1·1127	1·1142	1·1157	1·1172	1·1188
82·4	28	1·1067	1·1082	1·1097	1·1112	1·1127
84·2	29	1·1004	1·1019	1·1034	1·1049	1·1064
86	30	1·0943	1·0958	1·0973	1·0988	1·1002
87·8	31	1·0879	1·0893	1·0909	1·0923	1·0938
89·6	32	1·0814	1·0829	1·0843	1·0858	1·0873
91·4	33	1·0749	1·0764	1·0778	1·0793	1·0808
93·2	34	1·0681	1·0696	1·0710	1·0725	1·0740
95	35	1·0614	1·0629	1·0643	1·0658	1·0673

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF CARBONIC ACID AT VARIOUS TEMPERATURES AND PRESSURES.

° F.	° C.	720 mm. 28·35 in.	722 mm. 28·42 in.	724 mm. 28·50 in.	726 mm. 28·58 in.	728 mm. 28·66 in.	730 mm. 28·74 in.	732 mm. 28·82 in.
50	10	1·77446	1·77945	1·78445	1·78944	1·79443	1·79942	1·80441
51·8	11	1·76668	1·77165	1·77622	1·78160	1·78657	1·79155	1·79652
53·6	12	1·75881	1·76377	1·76873	1·77368	1·77864	1·78359	1·78855
55·4	13	1·75092	1·75587	1·76081	1·76576	1·77070	1·77565	1·78059
57·2	14	1·74301	1·74795	1·75288	1·75781	1·76275	1·76768	1·77261
59	15	1·73502	1·73993	1·74484	1·74974	1·75465	1·75955	1·76446
60·8	16	1·72699	1·73188	1·73677	1·74166	1·74655	1·75144	1·75633
62·6	17	1·71888	1·72376	1·72862	1·73349	1·73836	1·74322	1·74809
64·4	18	1·71069	1·71554	1·72040	1·72525	1·73011	1·73497	1·73982
66·2	19	1·70239	1·70723	1·71207	1·71691	1·72175	1·72659	1·73143
68	20	1·6941	1·69894	1·70377	1·70859	1·71341	1·71823	1·72305
69·8	21	1·68571	1·69051	1·69532	1·70012	1·70493	1·70974	1·71454
71·6	22	1·67722	1·68201	1·6868	1·69151	1·69638	1·70117	1·70596
73·4	23	1·66862	1·67340	1·67817	1·68294	1·68772	1·69219	1·69727
75·2	24	1·65994	1·66470	1·66945	1·67421	1·67897	1·68372	1·68848
77	25	1·65113	1·65587	1·66061	1·66535	1·67009	1·67484	1·67958

° F.	° C.	734 mm. 28·90 in.	736 mm. 28·98 in.	738 mm. 29·06 in.	740 mm. 29·13 in.	742 mm. 29·21 in.	744 mm. 29·29 in.	746 mm. 29·37 in.
50	10	1·80941	1·81440	1·81940	1·82438	1·82937	1·83437	1·83936
51·8	11	1·80149	1·80647	1·81144	1·81642	1·82139	1·82636	1·83134
53·6	12	1·79351	1·79846	1·80342	1·80838	1·81333	1·81829	1·82324
55·4	13	1·78554	1·79048	1·79543	1·80037	1·80532	1·81026	1·81521
57·2	14	1·77754	1·78248	1·78741	1·79234	1·79728	1·80221	1·80714
59	15	1·76937	1·77427	1·77918	1·78408	1·78899	1·79390	1·79880
60·8	16	1·76122	1·76611	1·77100	1·77590	1·78078	1·78567	1·79056
62·6	17	1·75296	1·72783	1·76269	1·76756	1·77243	1·77729	1·78216
64·4	18	1·74468	1·74953	1·75439	1·75925	1·76410	1·76896	1·77381
66·2	19	1·73627	1·74111	1·74595	1·75078	1·75562	1·76046	1·76530
68	20	1·72788	1.73270	1·73725	1·74234	1·74716	1·75199	1·75681
69·8	21	1·71935	1·72415	1·72896	1·73377	1·73857	1·74338	1·74818
71·6	22	1·71075	1·71554	1·72033	1·72512	1·72991	1·73470	1·73949
73·4	23	1·70204	1·70681	1·71159	1·71636	1·72114	1·72591	1·73068
75·2	24	1·69324	1·69799	1·70275	1·70751	1·71227	1·71702	1·72178
77	25	1·68432	1·68906	1·69380	1·69854	1·70329	1·70803	1·71277

TABLE SHOWING THE WEIGHT OF 1 CM.^{3} OF CARBONIC ACID, ETC.—*continued.*

° F.	° C.	748 mm. 29·45 in.	750 mm. 29·53 in.	752 mm. 29·61 in.	754 mm. 29·69 in.	756 mm. 29·76 in.	758 mm. 29·84 in.
50	10	1·84435	1·84934	1·85433	1·85933	1·86432	1·86931
51·8	11	1·83631	1·84129	1·84626	1·85123	1·85621	1·86118
53·6	12	1·82820	1·83315	1·83811	1·84307	1·84802	1·85298
55·4	13	1·82015	1·82510	1·83004	1·83499	1·83993	1·84488
57·2	14	1·81208	1·81701	1·82194	1·82687	1·83181	1·83674
59	15	1·80371	1·80861	1·81352	1·81843	1·82333	1·82824
60·8	16	1·79545	1·80034	1·80523	1·81012	1·81501	1·81990
62·6	17	1·78703	1·79189	1·79676	1·80163	1·80650	1·81136
64·4	18	1·77867	1·78353	1·78838	1·79324	1·70809	1·80295
66·2	19	1·77014	1·77498	1·77982	1.78466	1·78950	1·79434
68	20	1·76113	1·76645	1·77127	1·77610	1·78092	1·78574
69·8	21	1·75299	1·75780	1·76260	1·76741	1·77221	1·77702
71·6	22	1·74428	1·74907	1·75386	1·75865	1·76344	1·76823
73·4	23	1·73546	1·74023	1·74501	1·74978	1·75455	1·75933
75·2	24	1·72654	1·73129	1·73605	1·74081	1·74556	1·75032
77	25	1·71751	1·72225	1·72699	1·73173	1·73648	1·74122

° F.	° C.	760 mm. 29·92 in.	762 mm. 30·00 in.	764 mm. 30·08 in.	766 mm. 30·16 in.	768 mm. 30·24 in.	770 mm. 30·32 in.
50	10	1·87430	1·87930	1·88429	1·88928	1·89427	1·89926
51·8	11	1·86616	1·87113	1·87610	2·88108	1·88605	1·89103
53·6	12	1·85793	1·86289	1·86785	1·87280	1·87776	1·88271
55·4	13	1·84982	1·85477	1·85971	1·86466	1·86960	1·87455
57·2	14	1·84167	1·84661	1·85154	1·85647	1·86141	1·86634
59	15	1·83314	1·83805	1·84296	1·84786	1·85277	1·85767
60·8	16	1·82479	1·82938	1·83457	1·83946	1·84435	1·84924
62·6	17	1·81623	1·82110	1·82596	1·83083	1·83570	1·84056
64·4	18	1·80781	1·81266	1·81752	1·82337	1·82723	1·83209
66·2	19	1·79917	1·80401	1·80885	1·81369	1·81853	1·82337
68	20	1·79056	1·79538	1·80021	1·80503	1·80985	1·81467
69·8	21	1·78183	1·78663	1·79144	1·79624	1·80105	1·80586
71·6	22	1·77302	1·77781	1·78260	1·78739	1·79218	1·79697
73·4	23	1·76410	1·76888	1·77675	1·77842	1·78320	1·78797
75·2	24	1·75508	1·75981	1·76459	1·76935	1·77411	1·77886
77	25	1·74596	1·75070	1·75544	1·76018	1·76492	1·76967

VOLUME AND DENSITY OF WATER AT DIFFERENT TEMPERATURES.

Temp.	Sp. gr. of Water (at 0° = 1).	Vol. of Water (at 0° = 1).	Sp. gr. of Water (at 4° = 1).	Vol. of Water (at 4° = 1).
0°	1·000000	1·000000	·999871	1·000129
1	1·000057	0·999943	·999928	1·000072
2	1·000098	·999902	·999969	1·000031
3	1·000120	·999880	·999991	1·000009
4	1·000129	·999871	1·000000	1·000000
5	1·000119	·999881	0·999990	1·000010
6	1·000099	·999901	·999970	1·000030
7	1·000062	·999938	·999933	1·000067
8	1·000015	·999985	·999886	1·000114
9	0·999953	1·000047	·999824	1·000176
10	·999876	1·000124	·999747	1·000253
11	·999784	1·000216	·999655	1·000345
12	·999678	1·000322	·999549	1·000451
13	·999559	1·000441	·999430	1·000570
14	·999429	1·000572	·999299	1·000701
15	·999289	1·000712	·999160	1·000841
16	·999131	1·000870	·999002	1·000999
17	·998970	1·001031	·998841	1·001160
18	·998782	1·001219	·998654	1·001348
19	·998588	1·001413	·998460	1·001542
20	·998388	1·001615	·998259	1·001744
21	·998176	1·001828	·998047	1·001957
22	·997953	1·002049	·997826	1·002177

VOLUME AND DENSITY OF WATER AT DIFFERENT TEMPERATURES—*continued.*

Temp	Sp. gr. of Water (at 0° = 1).	Vol. of Water (at 0° = 1).	Sp. gr. of Water (at 4° = 1).	Vol. of Water (at 4° = 1).
23	·997730	1·002276	·997601	1·002405
24	·997495	1·002511	·997367	1·002641
25	·997249	1·002759	·997120	1·002888
26	·996994	1·003014	·996866	1·003144
27	·996732	1·003278	·996603	1·003408
28	·996460	1·003553	·996331	1·003682
29	·996179	1·003835	·996051	1·00 965
30	·995894	1·004123	·995765	1·004253
35	·99431	1·00572	·99418	1·00586
40	99248	1 00757	·99235	1·00770
50	·98833	1·01181	·98820	1·01195
60	·98351	1·01677	·98338	1·01691
70	·97807	1·02213	·97794	1·02256
80	·97206	1·02874	·97194	1·02887
90	·96568	1·03554	·96556	1·03567
100	·95878	1·04300	·95865	1·04312

SECTION VIII.—ANALYSIS.

(A) *QUALITATIVE ANALYSIS.*

DIRECTIONS FOR MAKING THE ORDINARY REAGENTS USED IN LABORATORIES.

ACIDS.

Sulphuric Acid (H_2SO_4), oil of vitriol. Impurities, Pb, As, Fe, Ca, HNO_3, N_2O_4.

Dilute Sulphuric Acid. Pour 1 part by measure of the pure concentrated acid into 5 parts of distilled water contained in a porcelain dish.

Nitric Acid (HNO_3), common. Impurities, H_2SO_4, HCl.

Dilute Nitric Acid. Dilute 1 part of the strong pure acid with 2 parts of water.

Hydrochloric Acid (HCl), common. The impurities are Cl, Fe_2Cl_6, H_2SO_4, SO_2, As.

Dilute Hydrochloric Acid. Dilute 1 part of pure concentrated acid with 3 parts of water.

Nitro-hydrochloric Acid (Aqua Regia). Prepare when required by adding 4 parts of strong hydrochloric acid to 1 part of strong nitric acid.

Acetic Acid ($H_4C_2O_2$). Impurities, H_2SO_4, HCl, Cu, Pb, Fe, Ca.

Dilute Acetic Acid. Mix 1 part of pure commercial acid of specific gravity 1·04 with 1 part of water.

Carbonic Acid (H_2CO_3). Make a solution of CO_2 by passing it into cold water.

Sulphurous Acid (H_2SO_3). Make a solution of SO_2 in water and preserve in well-stoppered bottles.

Oxalic Acid ($H_2C_2O_4$). Impurities, Fe, K, Na, Ca. Dissolve 1 part of crystallised acid in 10 parts by measure of water.

Tartaric Acid ($C_4H_6O_6$). Impurities, Ca, H_2SO_4. Make a solution when required by dissolving 1 part of acid in 3 parts of water.

Hydrofluoric Acid (HF). This acid is best purchased. It should be kept in a guttapercha bottle.

Hydrofluosilicic Acid (H_2SiF_6). Place in a capacious flask 1 part of sand, 1 part of CaF_2, 6 parts of concentrated sulphuric acid, and heat on a sand bath. A wide delivery tube, dipping into a beaker of water containing enough mercury at the bottom to cover the end of the tube, should convey the evolved gas. Filter the solution thus obtained.

Sulphuretted Hydrogen (SH_2). It is best to use this reagent in the gaseous state; it should in all cases be previously washed. A solution may be made and preserved for some time in stoppered bottles rendered opaque by varnish.

ALKALIES.

Sodic Hydrate (NaHO), or *Potassic Hydrate* (KHO). For most purposes of the laboratory sodic hydrate should be used. Dissolve the stick soda in 20 parts of water. Impurities, Al, SiO_2, phosphates, sulphates, and chlorides. Pure sodic hydrate for the separation of alumina can be bought. For organic analysis potash (not soda) of specific gravity 1·27 should be used.

Ammonic Hydrate (NH_4HO). Impurities, sulphate, chloride, carbonate, tarry matter.

Dilute Ammonic Hydrate. A solution of specific gravity ·96 (1 vol. of strong ammonia ·880 and 2 vol. of water) should be used.

Baric Hydrate (BaH_2O_2). Dissolve 1 part of the crystals ($BaH_2O_2 + 8Aq$) in 20 parts of water. Filter, and preserve in well-stoppered bottle.

Calcic Hydrate (CaH_2O_2). Dissolve lime in water, filter and preserve in stoppered bottle.

SALTS.

Salts of Alkalies.

Sodic Hydric Sulphite. Dissolve 1 part of the salt in 5 parts of water.

Disodic Hydric Phosphate. Impurities, sulphate, chloride, alkaline earthy phosphates. Dissolve the recrystallised salt in 10 parts of water.

Sodic Hypochlorite ($NaClO$). Obtained by passing chlorine into a cold dilute solution of soda, or by treating 1 part of fresh bleaching powder with 8 parts of water, and precipitating the solution with strong sodic carbonate solution. Filter for use.

Sodic Thiosulphate ($Na_2S_2O_3$). Dissolve 1 part of the salt in 30 parts of water.

Sodic Acetate ($NaC_2H_3O_2$). Impurities, sulphates. Dissolve 1 part of the commercial salt (if pure) in 10 parts of water. The pure salt may be made by neutralising sodic carbonate with pure acetic acid.

Sodic Acetate and *Acetic Acid* solution. Prepare by dissolving 25 grams of crystallised sodic acetate in 200 c.c. of water, and adding 50 c.c. of strong acetic acid.

Sodic Ammonic Hydric Phosphate (Microcosmic salt) ($Na(NH_4)HPO_4$). The salt must be dried and powdered. It can be made as follows: dissolve 7 parts of disodic hydric phosphate and 1 part of ammonic chloride in 2 parts of boiling water and allow to cool, when the salt forms. It is purified by recrystallising from hot water containing a little ammonia.

Sodic Borate ($Na_2B_4O_7$). Heat the crystals to expel water of crystallisation, powder, and preserve in bottles.

Sodic Carbonate (Na_2CO_3). Impurities, chlorides, phosphates, sulphates, silicates. A purer product can be obtained by heating the bicarbonate or by repeated recrystallisation of the commercial salt. Dissolve the anhydrous salt in 5 parts of water.

Ammonic Sulphate ($(NH_4)_2SO_4$). Recrystallise the commercial salt after the addition of ammonia, and make a strong solution.

Ammonic Chloride (NH_4Cl). Impurity, iron. Purify the commercial salt by the addition of ammonia, filter, neutralise the filtrate with hydrochloric acid and crystallise. Dissolve in 5 parts of water.

Ammonic Nitrate ($(NH_4)NO_3$). A saturated solution is made when required.

Ammonic Oxalate ($(NH_4)_2C_2O_4$). Recrystallised ammonic oxalate is dissolved in 20 parts of water.

Ammonic Carbonate ($(NH_4)_2CO_3$). Impurities, Pb, Fe, sulphates, chlorides. Scrape the ordinary commercial salt, and then dissolve in 4 parts of water, and add 1 part of ammonia of specific gravity ·880.

Ammonic Hydric Carbonate ($(NH_4)HCO_3$). Pass CO_2 into strong ammonia, dissolve the crystals thus obtained when required.

Ammonic Molybdate ($(NH_4)_2MO_4$). The salt is dissolved in strong ammonia, and the clear fluid decanted into strong nitric acid till the precipitate redis-olves. A very delicate reagent for the detection of phosphoric acid is made by taking the following proportions :—

60 grams ammonic molybdate
500 c. c. nitric acid (specific gravity 1·4)
400 c. c. ammonia (specific gravity ·96)
400 c. c. water.

Ammonic Sulphide ($(NH_4)_2S$). Saturate 3 parts of ammonia with SH_2, and then add 2 parts of ammonia.

Yellow Ammonic Sulphide ($(NH_4)_2S_2$). Digest the neutral SAm_2 with flowers of sulphur, and filter. This reagent is best bought,

Ammonic Arseniate is prepared by neutralising arsenic acid with ammonic carbonate and evaporating to dryness. Dissolve in water.

Potassic Sulphate (K_2SO_4). Dissolve 1 part of the salt in 10 parts of water.

Potassic Nitrite (KNO_2). Dissolve 1 part of the commercial salt in 2 parts of water when required.

Potassic Iodide (KI). The commercial salt is dissolved in 50 parts of water. Impurities, iodate, carbonate.

Potassic Chromate (K_2CrO_4). Impurities, sulphates. Dissolve in 10 parts of water.

Potassic Bichromate (K_2CrO_7). Dissolve in 10 parts of water. Impurities, sulphates.

Potassic Metantimoniate ($KSbO_3$). Heat 1 part of Sb with 4 parts of nitre in a crucible; boil the powdered mass with 12 parts of water for some hours, then filter.

Potassic Ferrocyanide (K_4FeCy_6). Dissolve the commercial salt in 12 parts of water.

Potassic Ferricyanide ($K_6Fe_2Cy_{12}$). Dissolve 1 part of the salt in 12 parts of water when required.

Potassic Sulphocyanate ($KCyS$). Dissolve 1 part of the salt in 10 of water.

Salts of Alkaline Earths.

Baric Chloride ($BaCl_2$). Purify the commercial salt if not pure by first passing SH_2 and then crystallising. Dissolve in 10 parts of water.

Baric Nitrate (BaN_2O_6). Dissolve in 15 parts of water.

Baric Carbonate ($BaCO_3$). To a solution of $BaCl_2$ add ammonia and then excess of ammonic carbonate, and wash the precipitate, which must then be preserved moist in wide-mouthed stoppered bottles.

Calcic Chloride ($CaCl_2$). Impurity, Fe. Dissolve in 5 parts of water.

Calcic Sulphate ($CaSO_4$). Make the solution by shaking up gypsum with water and then filtering.

Magnesic Sulphate ($MgSO_4$). Dissolve in 10 parts of water.

Magnesia Mixture.—Dissolve 83 grams of crystallised magnesium sulphate in boiling water, add 5 c.c. of hydrochloric acid, and then 82 grams of crystallised barium chloride previously dissolved in water. Filter off a few drops of the solution and add dilute sulphuric acid; if this gives a precipitate, add a little more magnesium sulphate. Then decant and filter, mix the filtrate and washings, and concentrate by evaporation. When cool, transfer to a litre flask, add 165 grams of pure ammonium chloride, 260 c. c. of ammonia, and then water to the mark. Allow to stand a few days, and filter if necessary

Salts of Heavy Metals.

Ferrous Sulphate ($FeSO_4$). Dissolve in 10 parts of *cold* water.

Ferric Chloride (Fe_2Cl_6). Dissolve pure $Fe_2H_6O_6$ in pure HCl. Leave an excess of $Fe_2H_6O_6$, and filter. When cool dilute with 2 volumes of water.

Cobaltous Nitrate (CoN_2O_6). Dissolve in 10 parts of water. Impurities, Fe, Ni, &c.

Plumbic Acetate ($PbC_4H_6O_4$). Dissolve in 10 parts of water.

Lead free from silver is prepared by precipitating pure plumbic acetate with metallic zinc.

Plumbic Peroxide (PbO_2). Digest red lead in hot dilute nitric acid, filter, and wash.

Cupric Sulphate ($CuSO_4$). Impurities, Fe, Zn. Dissolve the recrystallised salt in 10 parts of water.

Cupric Chloride ($CuCl_2$). Dissolve CuO in HCl, keeping the former in excess; filter.

Cuprous Chloride (Cu_2Cl_2). Prepared by digesting $CuCl_2$ with Cu and HCl.

Mercuric Chloride ($HgCl_2$). Dissolve corrosive sublimate in 20 parts of water with the aid of heat.

Mercurous Nitrate ($Hg_2N_2O_6$). Dissolve the commercial salt in 20 parts of water acidulated with 1·2 part of nitric acid. Put some metallic mercury into the filtered solution.

Auric Chloride ($AuCl_3$). Dissolve gold in aqua regia, evaporate on the water bath, add water, and filter.

Platinic Chloride ($PtCl_4$). Dissolve scrap platinum in aqua regia, add ammonic chloride, and evaporate on the water bath. Wash the residue with alcohol; decompose it by ignition. Dissolve the resulting platinum in aqua regia: evaporate to dryness with HCl, and dissolve in 10 parts of water.

Argentic Nitrate ($AgNO_3$). Dissolve the commercial salt in 20 parts of water.

Stannous Chloride ($SnCl_2$). Dissolve pure tin in strong HCl in presence of platinum foil. Dilute with four volumes of dilute hydrochloric acid. Keep in a stoppered bottle containing some pieces of granulated tin.

MISCELLANEOUS.

Chlorine (Cl_2). Pass the gas into cold water, and preserve in well-stoppered bottles in a dark place.

Hydric Peroxide (H_2O_2). Suspend baric peroxide in water, keep cool, and pass a current of CO_2. Filter off the precipitate from the solution, which should be dilute.

Nessler's Solution. Take 7 grams of KI and 3·2 grams of $HgCl_2$; dissolve the former in 20 c. c. of water, and then the latter in 60 c. c. of water; add the mercury solution to the other with constant shaking, until the precipitate ceases to redissolve. Then add 120 c. c. of potash, and filter.

Indigo Solution. Take 1 part of powdered indigo and 4 to 6 parts of fuming sulphuric acid; add the indigo in small portions to the acid with constant stirring, at the same time preventing rise of temperature. After the solution has stood a day or two, pour it into 20 times its volume of water, and filter.

Litmus Solution. Boil powdered litmus with distilled water.

Litmus Papers. Take Swedish filter paper, cut it into strips, and soak these in hot water. After they are well drained, soak them in the above litmus solution, which, if red papers are required, has been previously treated with a few drops of H_2SO_4, and if blue papers are required, with a few drops of potash. Dry and cut up, then preserve in stoppered bottles.

Turmeric Papers. Steep 1 part of bruised turmeric in 5 parts of weak alcohol. Make the papers with this solution as directed for litmus papers. See also page 403.

DRY REAGENTS.

Fusion Mixture.—Mix 10 parts of anhydrous sodium carbonate with 13 parts of anhydrous potassium carbonate.

Blax Flux.—Ignite Rochelle salt to redness in a covered crucible.

Soda Lime.—Take caustic soda of known sp. gr., and calculate the weight of NaHO present, add twice the latter weight of good quicklime, allow the slaking to take place, and evaporate to dryness in an iron dish. Heat the residue to redness in a crucible, and then reduce it to coarse powder by sifting.

Oxidising Fusion Mixtures.

(1) Anhydrous sodium carbonate 6 parts, potassic nitrate 4 parts.

(2) Anhydrous sodium carbonate 6 to 8 parts, potassic chlorate 1 part.

NOTES ON TESTING FOR COMMON SUBSTANCES OF DEFINITE CHARACTER. ELEMENTS, ACIDS, BASES, SALTS, ALCOHOLS, ETHERS, ETHEREAL SALTS, ETC., ETC.

The reader is presumed to have undergone an ordinary course of instruction in qualitative analysis.

A. The Substance is a liquid.

It is *inflammable.* Ether, Alcohol, Acetic Ether, Carbolic acid (liq.), Amyl Alcohol, Amyl Nitrite, Benzene, Benzoline, Chloroform, Creasote, &c.

It is *limpid.* Most of the above, with the exception of Carbolic acid (liq.), Creasote. Also most of the other liquids.

It is *not limpid.* Glycerine, Conc. Sulphuric acid, White of Egg.

It can be recognised by its *smell.* Such substances as Acetic Ether, Alcohol, Sulphurous acid, Amyl Nitrite, Benzol, Bromine, Chlorine water, Chloroform, Hydrocyanic acid, &c.

It is *coloured.* Bromine, Chlorine water, &c.

It has an *acid reaction.* The usual acids, Acetic, Sulphuric, &c. Also solutions of certain salts.

It has an *alkaline reaction.* Ammonia and other alkalies, mostly alkaloids, also some salts, as Borax.

It has a *neutral reaction.* Water; or a soln. of some salts of the alkalies, alkaline earths, or of Ag or Mn, of some alkaloidal salts or free alkaloids, neutral principles, &c.

It is *immiscible* with water. Ether, Chloroform, and most of the inflammable liquids, except Alcohol, Carbolic acid.

Evaporate a small quantity to dryness, taking care not to ignite it.

It goes off readily, *leaving no residue.* This at once excludes all fixed substances, such as metallic and alkaline salts.

It *leaves a residue,* but the solvent goes off readily. This shows the solvent to be water, or alcohol, or an ethereal liquid, &c.

It *gives off fumes.* Bromine, &c.

It *gives off heavy vapours.* Carbolic acid, Creasote, &c.

It *decomposes with acid vapours* (Glycerine); or *solidifies* (Albumen); &c., &c.

If there was a residue on evaporation, repeat this operation and ignite the residue.

It *remains fixed.* Salts of the metals, except As, Hg; or fixed acids, Phosphoric, Boric, &c.

Note.—A residue containing carbonate after ignition, and having an alkaline reaction, indicates that the original substance, itself not necessarily alkaline to litmus, was an organic salt of an alkali or alk. earth metal. Blackening on ignition indicates organic matter.

It *disappears.* Salts of Am, Alkaloids, As, Hg, with volatile acids. Solutions of Alkaloids, neutral principles.

Note.—The foregoing examination must not be taken as exhaustive, but it gives an idea of the kind of procedure that will be found useful. The operator having by some such means obtained indications of the nature of the liquid, or having excluded a number of bodies according to their want of certain properties, as inflammability, &c., should go on to apply special tests, according to his knowledge of the characters of substances. These tests must to a great extent be applied spontaneously; to lay down a system would in many cases unduly protract the final identification of the substance.

When a number of substances are mixed together, whether in solution or otherwise, their separation and detection require skill and experience in analysis, especially when the bodies are not bases or acids. In the case of these definite acid and basic substances, it is possible to draw out a scheme for their examination.

TABLE SHOWING THE BEHAVIOUR OF THE METALS (COMMON AND RARE) WITH A BORAX BEAD.

Contractions: l. q. means large quantity, and s. q. small quantity.

Colour of Bead.	In Oxidizing Flame when		In Reducing Flame when	
	Hot.	Cold.	Hot.	Cold.
Colourless	Si, Al, Sn, Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Te, Ta, Nb, W, Mo, Ti. Zn, Cd, Pb, Bi, Sb, in s. q., if not yellow.	Si, Al, Sn, Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Te, Ta, Nb, Ti, W, Mo, Zn, Cd. Pb, Bi, Sb, Ag Fe in s. q.	Si, Al, Sn, Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Di, Mn. Nb in s. q. Ag, Zn, Cd, Pb, Ni, Bi, Sb, Te, on long heat.; if not grey and opaque.	Si, Al, Sn, Di, Mn; Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Ce, Ta. Nb in s. q. Ag, Zn, Cd, Pb, Br, Sb, Ni, Te, on long heat.; if not grey and opaque. Fe in s. q.
Grey and opaque.	—	—	Ag, Zn, Cd, Pb, Sb, Ni, Fe, on short heat.; if not colourless. Nb in l. q.	Ag, Zn, Cd, Pb, Bi, Sb, Ni, Fe, on short heat.; if not colourless. Nb in l. q.
Pale yellow.	Ag, Cd, Zn, in l. q.	Ag	—	—
Yellow.	Ti, W, Pb, Sb, Mo, in l. q. U in s. q.	Va, Fe; Ce; U.	Ti in s. q., if not violet-blue. Mo in s. q.; if in l. q., brown. W, Va.	Mo, in l. q. opaque and brown. W, in l. q. brown.
Reddish yellow.	Cr, Fe, in s. q. Bi in l. q.	—	U	—
Red.	Ce	—	—	—
Dark red.	Fe in l. q.	Mn (violaceous).	—	—
Brownish red.	Cr, U	Ni	Cu	Cu
Violet.	Mn, Ni, Di	Di	—	Ti
Blue.	Co	Co; Cu (greenish while cooling.	Co	Co; Cu nearly colourless on long heat.
Green.	Cu	Cr (yellowish while cooling).	Fe. Cr (brownish), Cu, nearly colourless on long heat.	Fe, U, Cr, Va

TABLE SHOWING THE BEHAVIOUR OF THE METALS (COMMON AND RARE) WITH A BEAD OF MICROCOSMIC SALT.

Contractions: l. q. means large quantity, and s. q. small quantity.

Colour of Bead.	In Oxidizing Flame when		In Reducing Flame when	
	Hot.	Cold.	Hot.	Cold.
Colourless, with a floating "skeleton."	Si	Si	Si	Si
Colourless	Al, Sn, Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Nb, Te, in all proportions. Ta, Ti, W, Zn, Cd, Pb, Bi, Sb, in s. q., if not yellow.	Al, Sn; Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Te. Ce, Nb, Ta, Ti, W, Zn, Cd, Pb, Bi, Sb. Fe in s. q.	Al, Sn, Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La, Ce, Di, Mn; Ta, Ag, Zn, Cd, Pb, Bi, Sb, Ni, Te, on strong ignition; if not grey and opaque.	Al, Sn; Ba, Sr, Ca, Mg, Gl, Y, Zr, Th, La; Ce, Di, Mn, Ta; Ag, Zn, Cd, Pb, Bi, Sb, Ni, Te, on strong ignition; if not grey and opaque. Fe in s. q.
Grey and opaque.	—	—	Ag, Zn, Cd, Pb, Bi, Sb, Te, Ni.	Ag, Zn, Cd, Pb, Bi, Sb, Te, Ni.
Pale yellow.	Sb, Zn in l. q.	Ag, Fe	—	Fe
Yellow.	Pb in very l. q. Bi, Cd, Ta, Ti, W, in l. q. Ag, Ce, Ni, U, Va; Cr, Fe, in s. q.	Fe in l. q. Ni in s. q. U (greenish). Va	Ti	Fe (greenish) in l. q.
Reddish yellow.	Cr, Fe, in l. q.	Ni in l. q.	Fe in s. q.; Va	Fe while cooling.
Red.	—	—	Fe (brown)	—
Dark red.	—	—	—	Cu, opaque
Brownish red.	Ni; Fe, Cr, in very l. q.	—	Cr, Fe	Cu, opaque
Violet.	Mn, Di	Mn, Di	Nb in l. q.	Nb, Ti
Blue.	Co	Co, Cu, greenish while cooling.	Co, W; Nb in very l. q.	Co, W; Nb in very l. q.
Green.	Cu; Mo (yellowish).	Mo, U (greenish). Cr (emerald.	U, Mo, Cu	Cr, U, Mo, Va

EXAMINATION OF SOLIDS IN THE DRY WAY.

Experiment.	Observation.	Presence of
Heat in a piece of hard glass tube, closed at one end.	The substance—	
	blackens	Organic matter.
	becomes—	
	yellow when hot white when cold	Zn.
	yellowish brown when hot yellow when cold	Pb.
	white to yellowish brown when hot dirty light yellow when cold	Sn.
	white to orange when hot pale yellow when cold	Bi.
	brownish red to black when hot brownish red when cold	Fe.
	yellow to dark orange when hot	K_2CrO_4.
	gives off water, which, if alkaline, indicates Am., if acid, indicates volatile acids.	Water of crystallization, of hydration; or moisture.
	gives off gas or fumes—	
	O_2, test by splint	Peroxides, chlorates, nitrates.
	SO_2, test by odour	Sulphates, &c.
	N_2O_4, test by colour and odour	Nitrates of heavy metals.
	CO_2, test by drop of lime water on watch-glass	Carbonates, oxalates.
	CO_2 and CO, test by blue flame	Oxalates.
	CO, with marked charring	Formates.
	Cl_2, Br_2, I_2, test by colour and odour	Chlorides, bromides, or iodides.
	$(CN)_2$, test by odour and crimson flame	Cyanides.
	SH_2, test by odour and formation of PbS	Sulphides containing water.

EXAMINATION OF SOLIDS IN THE DRY WAY—*continued.*

Experiment.	Observation.	Presence of
Heat in a piece of hard glass tube, closed at one end.	The substance—	
	gives off gas or fumes—	
	NH_3, test by odour and turmeric paper	Ammonium salts, also cyanides and other nitrogenized matters.
	S_2	Persulphides.
	forms a sublimate of—	
	S_2 reddish brown drops when hot solid and yellow when cold	Persulphides.
	I_2 violet vapour, black sublimate	I_2.
	White matter	Ammonium salts, $HgCl_2$ (yellow-hot), Hg_2Cl_2, As_2O_3 (crystals), oxalic acid.
	As_4 black mirror	As_4.
	Hg mirror and globules	Hg.
	HgS black (turns red if rubbed)	Hg.
	Sb_2O_3 yellow liquid before subliming, then a sublimate of crystalline needles.	Sb.
Heat by the reducing flame in a cavity on charcoal.	fuses and is absorbed by the charcoal	Alkaline salts.
	leaves an infusible white residue (if alkaline, Ba, Sr, Ca, Mg).	Ba, Sr, Ca, Mg, Al, Zn, SiO_2.
	which, moistened with cobalt nitrate, and again heated, becomes blue	Al, SiO_2, alkaline earthy phosphates.
	green	Zn.
	pink	Mg.
	deflagrates	Nitrates, chlorates.

EXAMINATION OF SOLIDS IN THE DRY WAY—*continued.*

Experiment.	Observation.	Presence of
Heat by the reducing flame in a cavity on charcoal.	The substance—	
	forms an incrustation—	
	white, distant from flame, garlic odour	As_4.
	white nearer to flame	Sb_4.
	yellow when hot, white when cold	Zn.
	faint yellow when hot, white when cold, close to flame.	Sn.
	yellow	Pb.
	dark orange yellow while hot lemon yellow when cold	Bi_4.
	brownish red or yellow	Cd.
	dark red (slight)	Ag.
— mixed with KCy and Na_2CO_3.	forms metallic beads or scales without incrustation.	Ag, Au, Cu (beads), Fe, Co, Ni (magnetic scales).
	forms metallic scales, with incrustation, as above—	
	malleable bead	Sn, Pb.
	brittle bead	Bi_4, Sb_4.
Heat a fragment in a bead of microcosmic salt, or of borax. (See Table for beads, pp. 373-374.)	forms a coloured bead when hot—	
	blue	Co.
	green; on cooling, blue; in reducing flame, red	Cu.
	green, unaltered in reducing flame	Cr.
	reddish; yellow or colourless on cooling	Ni.
	amethyst red, colourless in reducing flame	Mn.
	brownish red; light yellow, on cooling; in reducing flame: yellow, hot; green, cold.	Fe.

EXAMINATION OF SOLIDS IN THE DRY WAY—*continued.*

Experiment.	Observation.	Presence of
Heat on a platinum wire with HCl.	The substance— colours the outer flame—	
	yellow	Na_2.
	violet	K_2 (observe through cobalt glass).
	crimson	Sr.
	brick red	Ca.
	green	Cu, B.
	blue	As_4, Sb_4, Pb, Cu.

EXAMINATION OF THE NEUTRAL OR ACID SOLUTION IN THE WET WAY.

If the solution is alkaline, the addition of hydrochloric acid may produce a precipitate consisting of, a salt of lead or silver insoluble in hydrochloric acid, SiH_4O_4, As_2S_3, Sb_2S_3, SnS_2, S_2, Au_2S_3, PtS_2, HgS, CuS, NiS, &c., this must be examined separately.

A.

Add moderate excess of HCl, filter. Wash the precipitate twice with cold water, and add the washings to the filtrate. Examine the filtrate by B. Treat the precipitate on the filter with hot water.

<table>
<tr><td colspan="2">Residue—treat on the filter with warm dilute AmHO, after well washing with hot water in presence of lead.</td><td rowspan="2">The filtrate from the washing with hot water may contain $PbCl_2$. Test for Pb by SH_2, H_2SO_4 and alcohol, or by K_2CrO_4.</td></tr>
<tr><td>Residue is black, indicating Hg. Confirm.</td><td>Filtrate, reacidulate with HNO_3. A white, curdy precipitate indicates Ag.</td></tr>
</table>

B.—*Examination of the Filtrate from A.*

(A small quantity of this filtrate should be treated with SH_2, if no precipitate forms, proceed to examine the bulk of the solution by C.) Dilute the filtrate from A if very acid, and pass excess of SH_2, filter and wash. Examine the filtrate by C. The residue is gently heated in a test tube with water and a little yellow ammonium sulphide (in presence of Cu and absence of Hg use sodium hydrate), filter, treat the residue once more with a little ammonium sulphide, and mix the two filtrates.

<table>
<tr>
<td colspan="4">Residue—wash, then boil with dilute HNO_3 (neglect sulphur clot which forms), and filter off a few drops, to which add H_2SO_4 and alcohol. If lead is present, a white precipitate forms. In the absence of lead, filter the whole of the liquid, and examine for Bi, Cu, and Cd by addition of AmHO, as below. In presence of lead add H_2SO_4 and alcohol, and filter.</td>
<td colspan="2">Filtrate—acidulate with HCl, filter, and wash the precipitate, which then digest with $(NH_4)HCO_3$; filter. (If the precipitate caused by HCl is brown or black, Au and Pt (and Sn″) may be present.)</td>
</tr>
<tr>
<td colspan="2">Residue—boil in $(NH_4)H_3C_2O_2$, and filter when cool.</td>
<td colspan="2">Filtrate—boil off the alcohol, if any is present, and add excess of AmHO; boil and filter.</td>
<td rowspan="2">Residue—dissolve in boiling HCl. Introduce into a small flask containing a strip of pure zinc and fitted with a delivery tube, SbH_3 is evolved if Sb is present. The mirror formed on porcelain is insoluble in cold sodic hypochlorite. The residue on the zinc must be detached by scraping, and boiled with HCl and a piece of platinum foil. The solution, diluted with water and mixed with $HgCl_2$, gives a precipitate of Hg_2Cl_2, at first white, but changing afterwards to grey Hg. This indicates presence of Sn.</td>
<td rowspan="2">Solution—acidulate with HCl, a yellow precipitate indicates As. Confirm.</td>
</tr>
<tr>
<td>Residue — dissolve in HCl by the aid of $KClO_3$, and test for Hg by a strip of copper. Or dry and heat in a bulb tube with Na_2CO_3 when metallic beads indicate Hg.</td>
<td>Filtrate—add K_2CrO_4, a yellow precipitate indicates Pb.</td>
<td>Precip.—dissolve in dilute HCl, evaporate nearly to dryness, and add much water; a milkiness indicates Bi.</td>
<td>Filtrate* — if blue, Cu is present; add KCy till the blue disappears, and then pass SH_2, a yellow precip. ind. Cd. In the absence of blue colour pass SH_2 at once.</td>
</tr>
</table>

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[*] Place a large drop of the ammoniacal liquid, if blue, on Swedish filter paper, and, after the drop has spread, expose to SH_2. A bright yellow ring fringing the black patch is formed, if Cd be present in sufficient quantity.

C.—*Examination of the Filtrate from* B.

Evaporate till free from SH_2, add a little nitric acid and take down to dryness; ignite to redness if organic matter (or oxalates) be suspected. Treat with a little strong HCl, and then add water. SiO_2 is left insoluble if present. Test* this solution for phosphoric acid with ammonic molybdate. In the absence of phosphoric acid examine by *Ca*, if phosphoric acid is present, by *Cb*.

Ca.

Add AmHO in excess, warm and filter. (If Mn is present, part of it often precipitates with the iron, and is best tested for by fusing some of the $Fe_2H_6O_6$ with Na_2CO_3 and KNO_3.)

<table>
<tr><td colspan="3">The precipitate, after being washed, is dissolved in HCl, and excess of <i>pure</i> NaHO added. The liquid is boiled and filtered.</td><td colspan="4">Filtrate — add SAm_2, filter and examine filtrate by D. Precipitate—wash, dissolve in HCl, add excess of NaHO, boil and filter.</td></tr>
<tr><td colspan="2">Residue—dissolve in HCl and boil with NaHO and NaClO in excess. Filter.</td><td rowspan="4">Filtrate—add excess of dilute HCl, and then add <i>slight</i> excess of AmHO and boil; a white gelatinous precipitate indicates Al.</td><td colspan="3">Precipitate—wash, dissolve in HCl, add slight excess of AmHO and then excess of $H_4C_2O_2$. Pass SH_2.</td><td rowspan="4">Filtrate—add SH_2. A white precipitate indicates Zn.</td></tr>
<tr><td>Residue—dissolve in HCl and add K_4FeCy_6. A blue precipitate indicates Fe.</td><td>Filtrate is yellow, add acetic acid and lead acetate. A yellow precipitate indicates Cr.</td><td colspan="2">Precipitate—dissolve in HCl and $KClO_3$, nearly neutralize with $NaCO_3$, add KCy till the precipitate at first formed redissolves (filter here if not clear). Boil till HCy disappears, cool, add NaClO, warm, and allow to stand until a black precipitate forms.</td><td rowspan="3">Solution—add AmHO, AmCl, and SAm_2. A flesh-coloured precipitate indicates Mn.</td></tr>
<tr><td colspan="2">Or, Residue—fuse with Na_2CO_3 and KNO_3, treat with hot water, and filter.</td><td rowspan="2">Precipitate is black. Presence of Ni.</td><td rowspan="2">Solution—evaporate a few drops to dryness, and heat the residue in a borax bead. Blue bead indicates Co.</td></tr>
<tr><td>Residue—treat as above for Fe.</td><td>Filtrate is yellow, treat as above for Cr.</td></tr>
</table>

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* This is best effected by mixing the liquid with molybdate solution and nitric acid in a test tube, and adding a quantity of fairly strong ammonia, so as to cause the latter to float. Somewhere between the two the conditions will be most favourable for the formation of the precipitate, and there a yellow ring will form in presence of a mere trace of phosphoric acid.

Add AmHO in excess and filter. To the filtrate add SAm_2 and filter; examine this filtrate by D. Wash the two precipitates separately, transfer them to the same dish, and digest with SAm_2. Filter.

<table>
<tr><td colspan="7">Precipitate—wash, dissolve in HCl (if the precipitate is black and also requires the addition of $KClO_3$ to dissolve it, Ni and Co are present), add a few drops of strong HNO_3, and test a small portion for phosphoric acid by molybdate. The presence of this acid indicates Cr, Al, Ba, Sr, Ca, Mg, as phosphates. (In the absence of phosphoric acid, proceed to examine the solution by Table *Ca*.) Add excess of $NaH_3C_2O_2$ and $H_4C_2O_2$, warm and filter.</td><td rowspan="5">Filtrate—test for phosphoric acid by Mg mixture, its presence indicates Fe, Ni, Co, Zn, Mn, as phosphates.</td></tr>
<tr><td colspan="3">Precipitate—wash, dissolve in HCl, add excess of NaHO in the cold, and filter.</td><td colspan="4">Filtrate—add Fe_2Cl_6 (if no white or reddish precipitate forms on testing a small portion, proceed to add AmHO and Am_2CO_3 to the remainder), as long as a precipitate forms, boil, and filter hot.</td></tr>
<tr><td rowspan="3">Precipitate, reddish brown, indicates Fe.</td><td colspan="2">Filtrate—boil for some time, and if a precipitate forms, filter.</td><td colspan="3">Filtrate—add AmCl, AmHO, and SAm_2; filter.</td><td rowspan="3">Precipitate, neglect.</td></tr>
<tr><td rowspan="2">Precipitate, green, indicates Cr as phosp. Confirm.</td><td rowspan="2">Solution—add excess of acetic acid. A white precipitate indicates Al as phosp. Confirm.</td><td colspan="2">Filtrate—Add Am_2CO_3.</td><td rowspan="2">Precipitate—examine for Zn, Mn, Ni, Co, Al, Cr, by Table *Ca*.</td></tr>
<tr><td>Precip.—examine by D for Ba, Sr, Ca.</td><td>Filtrate—add Na_2HPO_4. A white precipitate indicates Mg as phos. Confirm.</td></tr>
</table>

D.—*Examination of the Filtrate from* C.

Add AmCl and Am_2CO_3, digest and filter. Examine the filtrate by E. Wash the precipitate and dissolve in HCl, evaporate the solution to dryness, pulverize the residue, and digest it with absolute alcohol; filter.

<table>
<tr><td rowspan="2">Residue—dissolve in water and add K_2CrO_4. A yellow precipitate indicates Ba.</td><td colspan="2">Filtrate—add dilute H_2SO_4, allow to stand, and filter. Digest the precipitate with strong Am_2SO_4 and a little AmHO, and filter.</td></tr>
<tr><td>Residue indicates Sr. Confirm by flame.</td><td>Filtrate—dilute well, and add ammonium oxalate. A white precipitate indicates Ca.</td></tr>
</table>

E.—*Examination of the Filtrate from* D.

Divide it into two portions. To one add Na_2HPO_4 in the cold, a white crystalline precipitate indicates Mg. Evaporate a portion of the remainder and test by the flame for K and Na. Confirm K by $PtCl_4$.

TABLE SHOWING THE BEHAVIOUR OF THE

The vertical columns give the

Metal.	KHO, or NaHO.	K_2CO_3, or Na_2CO_3.	AmHO.
Na	—	—	—
K	—	—	—
Am	—	—	—
Mg	W MgH_2O_2	W $MgCO_3+xMgO$	W MgH_2O_2
Ba	W BaH_2O_2	W $BaCO_3$	No precipitate
Sr	W SrH_2O_2	W $SrCO_3$	No precipitate
Ca	W CaH_2O_2	W $CaCO_3$	No precipitate
Zn	W ZnH_2O_2	W $ZnCO_3+xZnO$	W $\underline{ZnH_2O_2}$
Mn	W MnH_2O_2	W $MnCO_3$	W MnH_2O_2
Ni	G NiH_2O_2	G $NiCO_3+xNiO$	————
Co	Bl CoH_2O_2+xCoO	P $CoCO_3+xCoO$	Bl $\underline{CoH_2O_2+xCoO}$
Fe^{IV}	R $Fe_2H_6O_6$	R $Fe_2H_6O_6$	R $Fe_2H_6O_6$
Cr	BlC $\underline{Cr_2H_2O_6}$	C Basic carbonate	BC $Cr_2H_2O_6$
Al	W $\underline{Al_2H_6O_6}$	W Basic carbonate	W $Al_2H_6O_6$
As^{III}	—	—	—
Sb^{III}	W $\underline{Sb_2O_3}$	W Sb_2O_3	W Sb_2O_3
Sn^{IV}	W $\underline{SnH_2O_3}$	W SnH_2O_3	W $\underline{SnH_2O_3}$
Sn^{II}	W $\underline{SnH_2O_2}$	—	W SnH_2O_2
Cd	W CdH_2O_2	W $CdCO_3$	W $\underline{CdH_2O_2}$
Cu	Bl CuH_2O	GBl $CuCO_3+xCuO$	GBl $\underline{\text{Basic}}$
Bi	W BiH_3O_3	W $Bi_2O_2CO_3$	W BiH_3O_3
Pb	W $\underline{PbH_2O_2}$	W $PbCO_3+xPbO$	W ————
Hg^{II}	Y HgO	RB $HgCO_3+xHgO$	W $2(NH_2HgCl)$
Hg^{I}	B Hg_2O	—	B Basic
Ag	Br Ag_2O	W Ag_2CO_3	Br $\underline{Ag_2O}$

A line ———— indicates that the precipitate is soluble in excess. The colour of the precipitate

B B = brownish black

METALS WITH THE COMMON REAGENTS.
formulæ of the precipitates.

Am_2CO_3.	SH_2.	SAm_2.	Other Reagents.	
			Name of Reagent.	Precipitate.
—	No precipitate	No precipitate	$KSbO_3$	W $NaSbO_3$
—	,,	,,	$PtCl_4$	Y $2KCl, PtCl_4$
—	,,	,,	$PtCl_4$	Y $2AmCl, PtCl_4$
—	,,	,,	Na_2HPO_4	W $MgHPO_4$
W $BaCO_3$	,,	,,	H_2SO_4	W $BaSO_4$
W $SrCO_3$	,,	,,	H_2SO_4	W $SrSO_4$
W $CaCO_3$	,,	,,	$Am_2C_2O_4$	W CaC_2O_4
W $\underline{ZnCo_3+xZnO}$	,,	W ZnS	—	—
W $MnCO_3$	,,	F MnS	—	—
G $\underline{NiCO_3+xNiO}$	No pp. if acid	B NiS	$NaClO$	B $Ni_3O_5, 4H_2O$
P $\underline{CoCO_3+xCoO}$	,,	B CoS	$NaClO$	B $Co_3O_5, 4H_2O$
R $Fe_2H_6O_6$	No precipitate	B FeS	K_4FeCy_6	Bl $Fe_4(FeCy_6)_3$
G Basic carbonate	,,	BlG $Cr_2H_2O_6$	—	—
W Basic carbonate	,,	W $Al_2H_6O_6$	—	—
—	Y As_2S_3	Y $\underline{As_2S_3}$	—	—
W Sb_2O_3	O Sb_2O_3	O $\underline{Sb_2O_3}$	—	—
W SnH_2O_3	Y SnS_2	Y $\underline{SnS_2}$	—	—
W SnH_2O_2	Br SnS	Br $\underline{SnS}$	—	—
W $CdCO_3$	Y CdS	Y CdS	—	—
GBl $\underline{\text{Basic}}$	BB CuS	BB CuS	K_4FeCy_6	RBr Cu_2FeCy_6
W $Bi_2O_2CO_3$	BB Bi_2S_3	BB Bi_2S_3	—	—
W $PbCO_3+xPbO$	B PbS	B PbS	H_2SO_4	W $PbSO_4$
W	B HgS	B HgS	KI	R $\underline{HgI_2}$
—	B Hg_2S	B Hg_2S	HCl	W Hg_2Cl_2
—	B Ag_2S	B Ag_2S	HCl	W $AgCl$

is indicated by capitals:—W = white; G = green; Bl = blue; Y = yellow; P = peach; B = black; Br = brown; R = red; F = flesh-coloured.

Preliminary Examination for Acids.

Many acidulous radicles may be detected by a preliminary examination. If the substance is in solution, evap. a portion to dryness.

Treat some of the residue, or a little of the original substance if this is a solid, with dilute HCl, applying heat to promote the reaction.

Certain gases may be given off, e.g. :—

CO_2 from Carbonates. The gas renders lime water milky.

SO_2 from Sulphites. The gas reduces a yell. soln. of Pot. Chrom. to a green Cr''' salt. If Zn and HCl be introduced to a soln. of a sulphite, H_2S is evolved.

SO_2, with deposition of S from hyposulphites (and mixt. of sulphides and sulphites).

HCy from Cyanides, but not from *stable* double cyanides, such as ferrocyanides, ferricyanides.

Cl from Hypochlorites. The gas liberates I from KI, as shown by a paper containing this body and also starch. The paper turns blue.

H_2S from Sulphides. The gas blackens paper moistened with lead acetate solution.

Certain acids may separate from the liquid at once or on cooling:—

Crystals.

- Benzoic acid from Benzoates. The odour of this acid is observed.
- Boric acid from Borates Mix the original with H_2SO_4 and alcoh.; set the mixt. on fire, the flame is green.
- Salicylic acid from Salicylates. The crys. washed with cold water and added to soln. of $FeCl_3$ cause a violet coloration.
- Meconic acid from Meconates may also separate.

Oleic acid from Oleates. The acid forms an oily layer.

Valerianic acid from Valerianates. This also may form an oily layer.

Heat another portion of the residue or the original solid with moderately conc. H_2SO_4. Besides the above mentioned,—

Certain gases resulting from decomposition may be evolved, e.g. :—

CO_2 and CO from Oxalates. The CO burns at the mouth of the tube on application of a flame.

O from MnO_2 and Chromates. The gas causes the reignition of a glowing splint.

Cl_2O_4 with explosion from Chlorates.

Acid vapours may be liberated, e.g.:—

HCl from Chlorides, HBr from Bromides, HI from Iodides, Acetic acid from Acetates, Valerianic acid from Valerianates. These acids are known by their odour.

HCy from Cyanides, and from the decomposition of double cyanides, such as Ferrocyanides, &c.

HNO_3 from Nitrates. The introduction of Cu into the liqd. causes evolution of NO, which forms NO_2 on mixing with air.

Blackening may occur in the liquid:—

Organic matter generally, with some exceptions, as oxalic acid. Tartaric, citric, tannic, and gallic acids, also salts of these, cause blackening.

Further Examination for Acids.

It is now expedient to remove the metallic bases, the nature of which has been determined in the usual manner. Certain of these may sometimes be conveniently removed by pptn. with H_2S, and the filtrate utilised for the detection of the acid, after removal of the H_2S by boiling (volatile acids may escape), or by treatment with Br water (when H_2SO_4 is formed from the H_2S). The H_2S may reduce certain acids, as chromic, permanganic, acids. A method more generally useful is by treatment with pure Na_2CO_3. The substance is boiled for some time with the carbonate, the liqd. diluted and filtered. Most bases are in this way removed, either as oxide, hydrate, or carbonate. The filtrate from Na_2CO_3 is divided into four portions—

(1) *A portion is acidultd. with HCl*, and test solns. added to small separate portions.

$BaCl_2$ ppts. white $BaSO_4$ from Sulphates. To the filtrate from this ppt. add Cl (or Br) water. If a further ppt. of $BaSO_4$ occurs, Sulphites are indicated.

Fe_2Cl_6 ppts. blue $3Fe'''Cy_2, 2Fe'''_2Cy_6$ from Ferrocyanides.

Fe_2Cl_6 gives a brownish colortn. with Ferricyanides. Confirm by addg. $FeSO_4$ when blue $Fe''_3Fe_2Cy_{16}$ is pptd.

Fe_2Cl_6 gives a blood-red colortn. with Meconates.

Fe_2Cl_6 gives a bluish-black colortn. with Tannates.

Fe_2Cl_6 gives a purple-black colortn. with Gallates.

Fe_2Cl_6 gives a red.-violet colortn. with Salicylates.
(Carbolic acid only with neutr. Fe_2Cl_6.)

Note.—Tannic acid ppts. gelatin ; gallic acid does not.

(2) *A portion is acidltd. with HNO_3*, and test solns. added to separate small portions.

$AgNO_3$ ppts. curdy white AgCl from Chlorides.
$AgNO_3$ ppts. curdy yell.-white AgBr from Bromides.
$AgNO_3$ ppts. curdy yell.-white AgI from Iodides.
$AgNO_3$ ppts. curdy white AgCN (sol. in excess of cyanide) from Cyanides.

$AgNO_3$ also gives ppts. with Ferrocyanides and Ferricyanides.

Note.—On treatment with Cl both bromides and iodides are decomposed, yielding Br and I respectively; chlorfm., if shaken with the liqd., dissolves the Br to a red soln. Both Cl and Br liberate I from iodides, and the resulting mixture turns starch paste blue. Cl (also Br and I) is liberated by $H_2SO_4 + MnO_2$, and the *gas* turns paper contg. starch and KI blue. $CuSO_4$ and $FeSO_4$ in solution together ppt. Cu_2I_2 from iodides. Nitrites in pres. of dil. HCl liberate I from iodides, but not Br from bromides. Chlorides mixed with a chromate (both dry), and heated with conc. H_2SO_4, evolve CrO_2Cl_2, which distils; if the distillate be treated with water, chromic and hydrochloric acid are formed, and the presence of *chromic* acid indicates the chloride. Bromides and iodides under the same circumstances simply evolve Br and I, but no volatile chromium compound. AgI is (almost) insol. in AmHO. AgCN yields metallic silver (sol. in HNO_3) upon ignition; AgCl, AgBr, AgI are not decomposed by ignition. These reactions afford means of distinguishing between the various salts. The cyanogen acids are most conveniently detected in a HCl solution.

(3) *A portion is acidultd. with acetic acid*, and test solns. added to separate small portions.

Fe_2Cl_6 ppts. whitish or yell.-white $Fe_2P_2O_8$ from Phosphates. Arsenic acid also ppts. if pres., and must previously be removed by H_2S.

Pb acetate ppts. yellow $PbCrO_4$ from Chromates.

$CaSO_4$ ppts. white CaC_2O_4 from Oxalates. Confirm by igniting the ppt. when it becomes $CaCO_3$, and dissolves in acet. acid with effervescence.

(4) *A portion is rendered neutral to litmus*, and test solns. added to separate small portions.

$AgNO_3$ ppts. yell. Ag_3PO_4 from Phosphates.

$CaCl_7$ ppts. white $CaC_4H_4O_6, 4Aq$ from Tartrates, and gives ppts. with other salts.

$CaCl_7$ ppts. white $Ca_3(C_6H_5O_7)_2+4Aq$ from Citrates, after additn. of lime water, or AmHO, and boiling. *CaH_2O_2 alone does the same on boiling.

Note.—*Tartaric acid when alone in pres. of citric may be detected by adding pot. acetate when KH•tartrate is thrown down. If the ppt. thrown down by $AgNO_3$ in a neutr. soln. be filtered off and dissold. in AmHO, the soln., after heating to about 70° for 10 min., deposits a brilliant mirror. Citric acid similarly treated gives an imperfect mirror, and then only after long boiling. These acids are indicated by an odour of burnt sugar during the preliminary exam. for bases.

$CaCl_2$ gives a white ppt. from Borates.

Fe_2Cl_6 ppts. pale yell. basic Fe benzoate from Benzoates.

Note.—If Mn, Cr, As, Sb, have been detected among the bases, the acids which these elements form should be looked for.

Permanganates are known by their purple solns., and the ease with which alcohol reduces them.

Arsenites in neutr. solns., or As_2O_3 in aq. soln., give a yell. ppt. of Ag_3AsO_3 with ammonio-nitrate of Ag.

Arseniates give a brick-red ppt. of Ag_3AsO_4 with $AgNO_3$.

TABLE SHOWING THE CHARACTERISTIC REACTIONS OF THE COMMON ACIDS.

The vertical columns give the formulæ of the precipitates.

Acid.	Fe_2Cl_6.	$BaCl_2$.	$AgNO_3$.	$CaCl_2$.	$Pb(H_3C_2O_2)_2$.	Other Reagents.		Nature of Solution.
						Name.	Precipitate, &c.	
H_2SO_4	—	W $BaSO_4$	—	—	—	—	—	Acidulated with HCl.
H_4SiO_4	—	—	—	—	—	AmCl	g H_4SiO_4	
$H_4\dot{F}eCy_6$	Bd $Fe_4(FeCy_6)_3$	—	These form pp. with $AgNO_3$ insol. in HNO_3	—	—	$FeSO_4$	Bl $K_2Fe''FeCy_6$	
”	—	—		—	—	$CuSO_4$	RBr Cu_2FeCy_6	
$H_6Fe_2Cy_{12}$	Br Coloration	—		—	—	—	—	
HCyS	R Coloration	—		—	—	—	—	
2HF, SiF_4	Wg BaF_2, SiF	—	—	—	—	—	—	
HCl	—	—	W AgCl	—	—	—	—	Acidulated with HNO_3.
HBr	—	—	YW AgBr	—	—	—	—	
$HBrO_3$	—	—	W $AgBrO_3$	—	—	—	—	
HI	—	—	Y AgI	—	—	$CuSO_4$ + $FeSO_4$	W Cu_2I_2	
HIO_3	—	—	W $AgIO_3$	—	—	—	—	
HCy	—	—	W AgCy	—	—	—	—	
HF	—	—	—	W CaF_2	—	The acid etches glass	—	Acid. with Acetic Acid.
$H_2C_2O_4$	—	—	—	—	—	$CaSO_4$	W CaC_2O_4	
H_2CrO_4	—	—	—	—	Y $PbCrO_4$	—	—	
H_3PO_4	YW $Fe_2P_2O_8$	—	—	—	—	—	—	
$\bar{T}H_2O_2$	—	—	—	W $\bar{T}CaO_2$	—	Forms Ag Mirror	—	Neutral.
$\bar{C}iH_3O_3$	—	—	—	W $\bar{C}i_2Ca_3O_6$*	—	—	—	

The capitals indicate the colour of the precipitate:—B = blue; Br = brown; Y = yellow; W = white; R = red; d = dark; l = light; g = gelatinous.

* On boiling with CaH_2O_2.

COLOUR REACTIONS.

With Sulphuric Acid.

(A) Place a small portion of the substance upon a piece of white porcelain (or testing tile), and drop upon it a little conc. sulphuric acid.

(*a*) (1) No colour, or only a slight yellowish discoloration, is produced.

Aconitine, Atropine, Caffeine, Codeine, Cinchonidine, Cinchonine, Cocaine, Morphine, Quinine, Quinidine, Strychnine, are indicated.

(2) It becomes *yellow*, changing to *red* Elaterin.

If no colour appears, the porcelain is gently warmed.

(3) The mass becomes deep brown, and finally *violet* .. .. Aconitine.

(4) The mass *chars*.. .. .. Cocaine.

(*b*) A coloration is produced.

(1) A *red* colour, with *green fluorescence* .. .. Veratrine.

(2) A *dark blood-red* soln., becoming colourless on dilution .. .. *Piperine.*

(3) A yellow colour .. .. Pilocarpine.

(4) A *golden yellow* † .. .. Picrotoxin.

(5) A *yellow colour*, changing to *green* Physostigmine.

(6) An *orange-red* colour .. .. .. ‡Chrysarobin.

(7) A *red* colour .. .. Salicin.

(B) The operation is repeated, with the addition of a *minute* crystal of potassium bichromate.

(1) A *violet* colour passing through *red* to *yellow*.. .. .. Strychnine.

(2) An *emerald-green* colour .. .. Pilocarpine.

(3) A *greenish* colour .. .. Morphine.

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† Mixed with three times its weight of KNO_3, moistened with sulphuric acid, and then treated with strong soln. of NaHO in excess, picrotoxin assumes a *brick-red* colour of short duration.

‡ Not a *pure* active principle.

(4) A *violet-red* .. .. Picrotoxin.†
(5) A *yellow resin* on heating .. .. Beberine.

Note.—Heated with a few drops of H_2SO_4, a little bichromate, and some water, it yields the vapours of an oil smelling of meadow-sweet .. .. Salicin.

(C) The operation is repeated, with the addition of a little arseniate of sodium, and warming.
A *bluish* tinge .. .. Morphine.

(D) The operation is repeated, using a 1% soln. of sodium molybdate in conc. sulphuric acid (Fröhde's reagent).
(1) A *violet* colour, passing to *blue* and *dirty green* .. .. Morphine.
(2) A deep *green* to *violet* colour .. Apomorphine.
(3) A *blue* colour (*dirty green* to *blue* and *yellow*, U.S.).. .. .. Codeine.

Note.—Also a blue with conc. H_2SO_4 and Fe_2Cl_6 with Codeine.

Note.—With melted carbolic acid the substance yields a soln. which, on the addition of sulphuric acid, acquires a *crimson* colour, rapidly changing to *scarlet*.. .. Elaterin.

With Nitric Acid.

(*a*) It remains colourless .. .. Quinine, Quinidine, Strychnine.

(*b*) It becomes coloured.
(1) It becomes *yellow*, but *not red* .. Codeine, Veratrine.

Note.—Veratrine may be distinguished by the colour tests already applied, and by the fact that when warmed with hydrochloric acid it dissolves with *blood-red* tint.

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† Mixed with three times its weight of KNO_3, moistened with sulphuric acid, and then treated with strong soln. of NaHO in excess, picrotoxin assumes a *brick-red* colour of short duration.

(2) It becomes faintly *greenish-violet* .. Pilocarpine.

(3) It becomes *orange-red* .. .. .. Morphine.

(4) It becomes *blood-red* .. .. .. Apomorphine.

(5) It becomes *greenish-yellow*, orange, and red, and gradually dissolves with a *reddish* colour. On adding to this soln. excess of soln. of KHO, the colour is at first pale yellow, but on boiling it deepens to *blood-red*, giving off alkaline vapours of the peculiar odour of piperine.. .. .. Piperine.

With Potassium Chlorate.

Add a crystal of $KClO_3$, and a few drops of HCl, to a little of the substance, and evap. to dryness in a porcelain dish.

A *reddish* residue results, which becomes *purple* when moistened with soln. of ammonia .. .. Caffeine.

With Alkalies.

(A) Add sod. bicarb. to a soln. in aq. A ppt. appears, which turns *green* on standing, and then forms a *purple* soln. with ether, *violet* with chlorofm., and *bluish-green* with alcohol .. .. Apomorphine.

(B) Warm or shake an aq. soln. with dilute soln. of KHO.

(1) It becomes *red*, and when evapd. to dryness, leaves a *bluish* residue, the acidified soln. of which is *dichroic* (blue *and* red) .. .. Physostigmine.

(2) It forms a *yellowish* to *reddish fluorescent* soln., which becomes *carmine* by absorption of oxygen from the air .. .. [†]Chrysarobin.

(C) Added to warm alcoholic soln. of HKO it gives a *violet-red* colour .. .. .. Santonin.

[†] Not a *pure* active principle.

(D) Warm a little of the substance with soln. of KHO.

Ammonia is evolved (from decomposition) .. .. Atropine, Hyoscyamine.

(Am salts of course give a similar reaction.)

With Platinic Chloride.

A sol. of the substance is treated with test soln. of Pt Cl_4.

No ppt. results.. .. .. Atropine, Hyoscyamine.

(Other alklds. for the most part give ppts.)

Note.—A soln. of $AuCl_3$ yields with these alklds. a precipitate which, when recrystallised from boilg. aq. acidltd. with HCl, is depostd. on coolg. (rendering the liqd. turbid) in minute crys., forming a dull lustreless powder on drying (atropine), or is deposited on coolg. (liquid not rendered turbid) in brilliant lustrous scales (hyoscyamine).

Fluorescence.

The substance is dissolved in dilute sulphuric acid.

(1) It is *fluorescent*.. .. .. Quinine, Quinidine.
(2) It is *not decidedly fluorescent* .. Cinchonidine, Cinchonine.

The Thalleioquin Test.

A soln., made as nearly neutral as possible, is treated with chlorine or bromine water, and then with excess of ammonia.

(1) A *green* ppt. or colortn. is produced Quinine, Quinidine.
(2) No green ppt. or colortn. results .. Cinchonidine, Cinchonine.

With Potassium Sodium Tartrate.

An aq. sol. is treated with a sol. of pot. sod. tart. (liquids not too dilute).

(1) No ppt. is produced.. .. .. .. Cinchonine.
(2) A ppt. is produced .. .. Cinchonidine.

Note.—The action of the sulphates of these two alklds. in aq. sol. may be examined by a polariscope; cinchonidine rotates to the left, cinchonine to the right.

General Examination of Animal Secretions.

Observe colour, taste, odour, reaction, sp. gr., &c. Filter off any insol. matter through paper or muslin, and examine microscopically.

(1) Take a portion of filtrate, make faintly acid (with acetic), and heat.

A ppt. occurs; *Albumin* or *phosphates* of Ca, Mg.

(*a*) Albumin is not dissol. by adding HCl, but on boilg. forms a *violet* solution.

(*b*) Phosphates of Ca, Mg, are sol. in HCl. Examine ppt. by microscope, &c.

Note.—If coagulum is reddish, dry a portion, and treat with alcohol contg. a little H_2SO_4; if alcohol becomes red, and its ash cont. Fe, *hæmatin* is present.

(2) The filtrate from (1) or original liquid if no ppt.—Divide into portions, A, B, C, &c.

A. Mix a portion with pot. ferrocyanide solution.

A ppt. occurs; *casein* and *globulin.*

(*a*) Mix another portion with $CaCl_2$ soln., and boil. Turbidity indicates casein.

(*b*) Mix another portion with acetic acid, and then add ammonia. A flaky ppt. indicates globulin.

B. Add acetic acid to a portion.

A ppt. occurs; *pus, mucus, chondrin.*

A portion mixed with $HgCl_2$ sol. gives a ppt.; pus is ind. If $HgCl_2$ gives merely a turbidity, mucus or chondrin may be present. Chondrin forms a jelly on concentrating a portion of the liquid; confirm by special tests.

(*b*) Filtrate or liq. from B, concentrate a portion and cool; a jelly indicates *gelatin.* Confirm by adding $HgCl_2$ to another portion; a ppt. confirms gelatin.

(3) (c) Concentrate to $\frac{1}{2}$ or $\frac{1}{3}$ and cool.

A ppt. occurs: *Urates, Ca sulphate, Mg phosphate* (*benzoic acid, calcic hippurate, tyrosin, allantoin;* these are crys.).

Ppt. under microscope is amorph., but on adding acetic acid is seen to become crys.; *uric acid* is indicated.

Ppt. is crys., and acetic acid does not alter it; *Ca sulphate, Mg phosphate.* Examine by ordinary tests.

(4) The filtrate from C is evapd. to a *syrup*, and left to stand for a considerable time.

Crystals occur; *creatine, creatinine, glycocine, leucine, allantoin, taurine, sarcosine, inosite, alkaline hippurates;* inorganic salts.

The crys. must be separated from the syrup by draining, &c., and tested as to whether organic or inorganic. If organic, examine for N, S, and P as a guide to further special examination. If inorganic, test by usual methods. Mineral salts of organic acids form an ash consisting of carbonates.

(5) The syrup from (4) if no crystals, or the drainings from the crys., is evapd. to dryness on water-bath, and residue extracted with alcoh. (sp. gr. ·83).

Residue may contain *mucus, extractive matters;* a little casein, uric acid, &c.

Solution.—Divide into portions, *a*, *b*, *c*.

(*a*) Concentrate and divide into portions, 1, 2, 3 (a large portion), 4.

(1) Add syrupy $ZnCl_2$, and allow to stand. A ppt. indicates *creatinine* (and creatine in presence of creatinine).

(2) Dilute with water, and add *fuming* nitric acid drop by drop. A zone successively green, blue, violet, red, yellowish, indicates *biliary colouring matter.*

(3) Mix with nitric acid, quite free from nitrous acid, and place vessel in a cooling mixture. A deposit of crys. indicates *urea* (as nitrate), *hippuric* or *benzoic* acid. It may consist of alkaline nitrates.

Examine by microscope and chemical tests.

(4) If the alcoholic extract has a strong acid reaction, a little of the conc. extract is boiled with ZnO and filtered; a drop is placed on a slide, and examined by microscope for crystals and lactate of zinc, indicating *lactic acid.*

(*b*) Examine for *biliary acids* by Pettenkofer's test, p. 396.

(*c*) Examine for sugar by Fehling's test, p. 510.

(6) A portion of the *original* is evapd. to dryness, extracted with ether, and the ether extract evapd. for *fats.*

(7) The portion of residue insol. in ether is burnt to ash, and examined for *inorganic salts.*

Examination of Calculi.

A calculus is any kind of concretion found in a duct or passage of a glandular organ, but the term has by some been restricted to calculi connected with the urinary system. The general character of these concretions may be gathered from the following summary.

Biliary Calculi or gall-stones.—*Size:* small grains to masses of more than an ounce. *Shape:* round or oval when solitary; when numerous, more or less facetted from compression. *Colour:* blackish-green or brown, sometimes yellow or yellowish-white. *Consistence:* soft, or hard, dry, and friable. *Composition:* gall-stones consist almost entirely of cholesterin and bile pigments, sometimes containing as much as 80 % of the first named constituent. The bile pigments are sometimes present in an uncombined condition, sometimes united with lime. Lime salts of the bile acids in small quantity, and lime salts of the fatty acids, are found, also carbonate and phosphate of lime, but not often in large quantity. Other constituents are copper, iron, and manganese, which are found in nearly all gall-stones. In examining a biliary calculus, first make a determination of the ash and of the inorganic matters, acids (CO_2, P_2O_5, &c.), and bases (Ca, Fe, Mn, Cu, &c.) that compose it. Afterwards powder another portion, and exhaust with ether, which upon evaporation yields cholesterin in an amorphous form. The cholesterin may be obtained in the characteristic glistening, rhombic plates (insol. in KHO soln.) by dissolution in hot alcohol, and cooling of the solution. The residue should next be exhausted successively with water, alcohol, and dilute hydrochloric acid; it is now dried, and exhausted with chloroform, and the chloroform extract concentrated nearly to dryness. The addition of several volumes of alcohol now produces an orange-red precipitate of bilirubin, which is insol. in water and ether, but slightly sol. in alcohol. Bilirubin is sol. in alkalies to yellow or orange solutions, which turn green, owing to formation of biliverdin, when submitted to a current of air. If to the alkaline solution is added an equal volume of alcohol, and then fuming nitric acid containing nitrous vapours, it becomes successively green, blue, violet, and red, passing finally to yellow again.

An alcoholic extract of the calculus contains the biliary acids. The solution has a bitter taste, and should be evaporated to dryness, and the residue dissolved in a little water. One drop of sugar solution (1 in 4 pts. aq.) is then stirred in, and pure strong H_2SO_4 added in small quantities at a time until the turbidity at first formed disappears, cooling after each addition. A transient yellowish tint at first appears, changing subsequently and successively to pale cherry-red, deep carmine, purple, and intense violet. In applying this test (Pettenkofer's), an excess of sugar must not be used (or the liquid chars), and the temperature must be kept at about 50° C., but not higher.

Intestinal Calculi are not common in man; they are sometimes met with in the case of persons who eat oatmeal largely, and then consist of hairs and fragments of the oat encrusted with calcium phosphate and carbonate. The habitual use of magnesium carbonate may also give rise to concretions in the bowels.

Pancreatic Calculi are very rare; when found they are usually of oval shape, with a worm-eaten appearance upon the surface, which is of whitish colour, and acquires an enamel-like lustre when rubbed. The fracture is white, and glistens somewhat like porcelain. Analysis has shown one sample to contain 24 % of organic matter, and 76 % of inorganic, chiefly calcium carbonate, with a little phosphate.

Prostatic Calculi consist essentially of calcium carbonate and phosphate; small quantities of uric acid, calcium oxalate, and ammonium-magnesium phosphate may be present.

Salivary Calculi consist chiefly of calcium carbonate with traces of phosphate.

Urinary Calculi vary considerably in size, shape, and colour. They may contain calcium oxalate, calcium phosphate, magnesium phosphate, ammonium-magnesium phosphate, calcium carbonate, uric acid, urates, cystine, xanthine, blood, fatty substance, &c.

A General Method for the Examination of Animal Calculi.

Subject a portion of the calculus in the state of powder to the action of the air at a red heat.

(A) It burns away, leaving little or no ash. Absence of mineral matters in more than traces. Probable presence of cholesterin, biliary colouring matters, fibrin, albumin, uric acid, Am urate, Am hippurate, cystine, or xanthine.

(*a*) A portion is treated with conc. HNO_3, the sol. evapd. to dryness, and the residue treated with a drop of Liq. Ammoniæ (Murexide test).

(1) A *purple-red* is produced. Uric acid or Am urate.

(Am must be tested for by shaking up with KHO.)

(2) No *purple-red* is produced, but

(*α*) The nitric acid soln. becomes *yellow* during evapn., and leaves a residue insol. in soln. of pot. carb. Xanthine.

(*β*) Or the nitric acid soln. becomes dark brown on evapn., and leaves a residue which dissol. in Liq. Ammon. to a soln. which deposits microscopical hexagonal plates of cystine.

(*b*) A portion is treated with soln. of KHO (Liq. Pot.).

(1) It dissolves and is repptd. by acetic acid, but redissol. by excess of the acid to a soln. which gives a ppt. with K ferrocyanide. Fibrine.

(2) It dissolves to a dark brown soln., which with nitric acid gives the colour reactions of biliary colouring matters, v. p.

(*c*) A portion is treated with boilg. alcohol.

(1) It is crystalline and dissolves, giving reactions of cholesterin, v. p.

(2) The soln. has a bitter taste, and with Pettenkofer's test gives the reactions of biliary acids, v. p.

Note.—Calculi contg. fibrine and biliary acids and colg. matters evolve the odour of calcined animal matters on ignition.

) It is almost entirely fixed (absence of organic matters), or it burns away only partially (Na or Ca urate, &c.).

(*a*) It does not contain uric acid, v. sup.

(1) The residue after ignition melts easily. It is fusible calculus, consisting of Ca phosphate, with Am Mg phosphate, &c. Apply the ordinary tests.

(2) The residue after ignition does not melt.

(*α*) The residue is neutral to litmus paper. Ca phosphate. Apply the ordinary tests.

(*β*) The residue is alkaline to litmus. Ca oxalate or carbonate. Apply the ordinary tests.

(*b*) It contains uric acid.
  (1) It melts on ignition, colouring the flame yellow, Na urate; or violet, K urate.
  (2) It does not melt on ignition, but yields a residue which dissolves in acid with effervescence, and is either $CaCO_3$ from Ca urate, or Mg carb. from Mg urate. Apply the ordinary tests for these metals.

The results of the examination by this scheme should now by confirmed by other reactions of the bodies detected.

The Examination of Urine.

Deposit.—Healthy urine is clear when passed, but after a time deposits a light flocculent precipitate consisting of mucus and epithelial cells. A deposit of oxalate of lime occurs in some instances, but more often an abnormal deposit consists of urates or phosphates. In order to distinguish between these it is only necessary to warm the urine, when the deposit dissolves in case of urates, but persists when it is due to phosphates. A cloudiness caused by phosphates is removed by the addition of a few drops of acetic acid. Mucus and pus also cause deposits, but these are not removed by acidulation. The presence of albumin distinguishes a turbidity due to pus from one due to mucus; in the former case the cloudiness is increased by the addition of soln. of pot. ferrocy. to the acidulated urine, while in the latter case there is no increase of turbidity. In order to distinguish between a deposit due to pus and one caused by mucus in albuminous urine, the urine is allowed to subside, and the clear portion decanted. The sediment is then submitted to the action of a small piece of caustic potash; if on stirring it becomes mucilaginous, pus is present; a sediment of mucus remains thin.

Colour.—Urine may be pale, normal, high coloured, or dark when viewed in a glass vessel 3 or 4 inches in diameter; normal urine under these circumstances appears golden to orange yellow. Dark urine is usually caused by bile, hæmoglobin, or blood; bile imparts a brown or greenish tint, and the two latter cause various shades of blood-red or coffee colour. With pus present in large amount in strongly alkaline urine the colour may be greenish-brown; carbolic acid or creasote also cause dark urine, and in cases of melanotic cancer, the urine, normal at first, may become dark from oxidation upon standing.

Specific Gravity.—This may be ascertained by the urinometer (a special form of hydrometer), or by the sp. gr. bottle. The sp. gr. of normal urine, determined at 60° F., varies between 1020 and 1025, the average being about 1020. The whole quantity passed should be well mixed in taking a sample for this test.

Reaction.—Healthy urine is usually acid, but may be neutral or even alkaline after a meal, or after the taking of alkaline medicines. After standing some time the reaction becomes alkaline. Alkalinity due to ammonia is distinguished from that due to fixed alkalies by the blueness of the test-paper disappearing upon drying When ammonium carbonate is the cause of alkalinity, ammonia gas is evolved on boiling with a few drops of soln. of KHO. Sometimes the reaction of urine is amphoteric (turning both red and blue litmus).

Normal Constituents of urine are (1) *nitrogenous bodies*—urea, uric acid, allantoin, oxaluric acid, xanthine, creatinine, sulphocyanic acid, &c.; (2) *ferments*—pepsin, pytalin; (3) *salts*—silicates, phosphates, sulphates, chlorides of K, Na, Ca, Mg, Fe; (4) *acids*—oxalic, lactic, glycerophosphoric (?), sulphuric, ether-sulphuric acids; and (5) *pigments* and *chromogens*.

Abnormal constituents are albumins, blood, hæmoglobin, methæmoglobin, bile-pigments, biliary acids, glucose, lactose, leucin, tyrosin, cystin, Ca oxalate, &c.

The *total solids* are found by evapn. and weighing of dried residue, or approximately by multiplying last two figures of sp gr. by 2·33 (= pts. per 1000). *Urea* is determined by treating 5 c.c. of urine with 40 or 50 c.c. of fresh hypobromite soln. (NaHO 100 p., aq. 250 p., addg. Br 25 p. when cold). The evolved N gas gives the urea. *Uric acid* may be determined by acidg. with $\frac{1}{20}$ vol. hydrochl. acid, collecting and weighing deposit after 24 hours (on weighed filter); or the deposit may be boiled with PbO_2 and aq., and the N estimated by hypobromite ($N \times 3 =$ uric acid, adding ·0045 G. per 100 c.c. of urine taken).

Uric acid may also be determined by pptg. as zinc urate (after previous removal of phosphates with Liq. Sodæ), and decomposition of this ppt. with hypobromite; 100 c.c. of urine may be employed. *Urates* occur as whitish or reddish deposit; under microscope Na and Ca urates are generally amorphous, Na·urate sometimes resembles hedgehogs; Am urate, opaque globules or slender dumb-bells which are single, crossed, or rosetted. *Phosphates* are always deposited as alkalinity develops; the Mg, Ca, P_2O_5 may be detected by usual methods. Under microscope Ca phosph. is amorph., the AmMg salt in rhombic prisms (sol. in acetic acid). *Ca oxalate* occurs in octahedrons or dumb-bells; it is colourless, insol. in alkalies and acetic acid. *Sulphuric acid* is estimated directly as $SrSO_4$ (sulphates); after boiling another portion with HNO_3 and $KClO_3$ (diff. = oxidisable S); by fusing residue of urine with KNO_3 the difficultly oxidisable sulphur is obtained by difference. *Chlorides* estimated as AgCl. *Albumen* is indicated by a deposit, insol. on adding a drop of acid (picric being the best) on boiling the urine. *Sugar* may be estimated by Fehling's* soln., by the polarimeter, by loss of sp. gr. on fermentation, &c. (Fehling's soln.—Cu sulph. crys., 34·64 G; Rochelle salt, 173 G; NaHO soln. (sp. gr. 1·14) 480 c.c.; make up to 1000 c.c.; 10 c.c. = ·05 G glucose, $C_6H_{12}O_6$.) For detection boil urine with this soln.; for estimation deliver dil. urine (1 in 10 p. aq.) from burette into 10 c.c. of Fehling's soln., dild. and boiling into a dish, adding urine little at a time till colour goes entirely. The (original) vol. of urine necessary to decolorise conts. ·05 G glucose. Use average of urine passed in 24 hours. Uric acid also gives a ppt. with the soln., but not on standing in the cold as sugar does. Johnson *detects* sugar by mixing Liq. Potass. with urine, boiling and adding picric acid; sugar causes a deep red colour. *Blood* may be detected by adding urine to an emulsion of Tr. Guaiac. and oil of turp.; an intense blue colour results in presence of blood. It may also be detected by its absorption spectrum.

Biliary acids, v. p. 396.

Biliary colourg. matter is indicated by colour (v. supra); a yellow scum forms on surface after agitation, and the urine has a bitter taste. *Leucin* may be extracted from the residue of urine (after treatment with Pb acetate and removal of Pb) with boilg. alcoh. It separates (on evapg. off alcoh. to a syrup) in crys., appearing under microscope as round balls with peculiar radiating or concentric markings. *Tyrosin* is obtained in similar manner, but is extracted by boilg. aq. from resid. insol. in alcoh. It forms fine colorlss. needles, and Hg nitrate boiled with it in sol. gives rosy red colour and ppt. *Cystine*, see Calculi, p. 397. *Accidental pigments* from food, &c., may be present.

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* Or the Gerrard-Allen cyano-cupric solution.

The Examination of Vomit.

The vomit is filtered through canvas or muslin, and the solid matter remaining on the filter examined by inspection and otherwise. The liq. passing the filter is allowed to settle.

The Filtrate.—The reaction is determined by litmus paper. The pres. of free hydrochloric acid is detected by methyl-orange, which becomes red in pres. of mineral acids. It must be remembered that lactic acid displaces not only volatile acids, but even hydrochloric and other mineral acids from their salts. The *volatile acids* are separated by distillation. From the non-volatile *lactic acid* may be separated by saturating with ZnO, and evapg. to dryness; the residue is digested with alcohol, when zinc lactate remains insoluble. The acetic and butyric salts of zinc dissolve in alcohol, and these acids may be separated by evapg. the distillate to a low bulk, acidltg. with HCl, and saturatg. the liqd. with $CaCl_2$. On shaking the soln. with ether *butyric acid* passes into the ether, while *acetic acid* remains in the aqueous layer. To test for *pepsin* add an equal vol. of dil. HCl (10 ♏ of Acid. Hy. Dil. B.P. to 1 ℥ of aq.), and a flake of hard-boiled white of egg; pepsin, if present, causes the dissolution of the albumen. *Trypsin* may be detected by proceeding in a similar manner, but omitting the acid, and rendering the liqd. slightly alkaline with sod. bicarb. Peptone may be detected by dialysing and treating the outer liqd. with $HgCl_2$, which ppts. peptones, or with KHO and a drop of dil. soln. of $CuSO_4$, which gives a ppt., soluble on shaking, to a soln., which is red, and becomes purple on adding more copper soln. Blood, bile, &c., should also be looked for.

Waldo.

The Detection of Vegetable Alkaloids, Glucosides, Etc.

The following is an outline of Dragendorff's process.

Extract the comminuted substance with water aciduld. with sulphuric or acetic acid. Add alcohol to syrup obtained by evapn. and filter. Distil off alcohol and again filter. Treat aqueous acid liquid with the following immiscible solvents in succession, separating each before applying the next:—Petroleum Ether, Benzene, Chloroform. Separate residual dissolved chlorofm. by petr. ether and alkalise with ammonia. Shake in succession as before with Petroleum Ether, Benzene, Chloroform, Amyl Alcohol. The residual aqueous liquid may contain *curarine*. The solvents will have separated the substances as indicated in the following table:—

In ammoniacal liquid.	Amyl alcohol.	*Convallamarin*, *Morphine*, *Narceine*, *Salicin*, *Saponin*, *Senegin*, *Solanine*.
	Chlorofm.	Celandine alkd., *Cinchonine*, *Morphine*, *Narceine*, *Papaverine*.
	Benzene.	*Aconellin*, *Aconitine*, *Atropine*, *Brucine*, *Cinchonine*, *Codeine*, *Delphinine*, *Emetine*, *Ethyl-strychnine*, *Hyoscyamine*, *Methyl-strychnine*, *Napelline*, *Narcotine*, *Nepaline*, *Physostigmine*, *Quinine*, *Sabadilline*, *Sabatrine*, *Strychnine*, *Thebaine*, *Veratrine*.
	Petr. ether.	*Aniline*, *Brucine*, Capsicum, *Conine*, *Emetin*, *Lobeline*, *Methyl-conine*, *Nicotine*, Pimento, *Quinine*, *Sabadilline*, *Sarracenin*, *Sparteine*, *Strychnine*, *Trimethylamine*, *Veratrine*. HCl added in evapn. if odorous liquid (vol. alkald.) left on evap. small portion.
From acid liquid.	Chlorofm.	Amorph.—*Convallamarin*, *Digitalin*, *Jervine*, *Saponin*, *Senegin*, *Smilacin*, *Syringin*. Crystne.—*Cinchonine*, *Helleborin*, *Narceine*, *Papaverine*, *Picrotoxin*, *Theobromine*.
	Benzene.	Amorph. Colourless or Pale Yellow.—*Colocynthin*, *Elaterin*, Pimento, *Populin*. Amorph. Yellow.—*Chrysammic acid*, *Colchicine*, *Quassiin*, Wormwood, &c. Crystne. Colourless.—*Berberine*, *Cantharidin*, *Cascarillin*, *Cubebin*, *Digitalin*, *Santonin*, *Theine*. Crystne. Yellow.—*Aloetin* (*Picric acid*, *Piperin*).
	Petr. ether.	Volatile.—*Phenol*, and essent. oils. Amorph.—Aconite, *Capsicin*, Hellebore. Crystne. and Volat.—*Picric acid*, *Piperin*. Crys. Colourless, Fusible, Odorous.—Camphor, &c.

(B) *VOLUMETRIC ANALYSIS.*

Preparation of the Solutions used in Volumetric Analysis.

Indicators.

The system adopted in this section is the same as that followed by F. Sutton in his 'Handbook of Volumetric Analysis,' the standard work in English (to which refer for details of processes).

The atomic weights are the usual approximations used in ordinary laboratory work, in which H = 1, O = 16, &c.

The normal temperature is 16° C.

A *normal* solution N is a solution containing the gram-equivalents referred to 1 atom of H per litre.

Water always means distilled water unless otherwise stated.

Cochineal.—Digest 1 part of the crushed insects with 10 parts of 25 per cent. alcohol and filter. The solution is yellowish-red, becomes violet with alkalies, and the colour is restored by mineral acids. It may be used in artificial light, but is useless in presence of traces of Fe or Al or acetates.

Litmus.—Extract the litmus with warm distilled water several times, mix the extracts, clarify and dialyse, when the colouring matter, which is colloidal, is obtained free from the chief impurities. Keep in a bottle with gauze cap without stopper, and add a few drops of chloroform to prevent growth of organisms. The tint is adjusted to neutrality with hydrochloric acid. This indicator is not adapted for use in gas light, and it is sensitive to CO_2. In *the cold* it is useful for NaHO, KHO, AmHO, CaH_2O_2, BaH_2O_2, SrH_2O_2; arsenites and silicates of Na, K; mineral and oxalic acids. When *boiling* it is useful for carbonates and sulphides of alkalies and alk-earths.

Turmeric.—Prepare a tincture of the comminuted root after well washing it with water. It is chiefly used as turmeric paper.

Methyl-orange (para-dimethylaniline-azo-benzone sulphonic acid).—Dissolve 1 part in 1000 parts water. It changes from yellow to pink with mineral acids and is unaffected by CO_2. It serves for the determination of hydrates, carbonates, bicarbonates, silicates, arsenites, sulphides, borates, of Na, K, Am, Mg, Ca, Sr, Ba; mineral acids, sulphites.

(*Turn to p.* 407 *for continuation.*)

Table showing Indications given by Litmus, Methyl-orange, Phenacetolin, Phenolphthalein and Rosolic Acid with various Salts of Alkalies ($M = K$ or Na, not Am) with Ammonia and with some Acids. (From R. T. Thompson's Results.)

Indicator.	MHO.	M_2CO_3.	$MHCO_3$.	M_2CO_3 MHO together.	M_2CO_3 $MHCO_3$ together.	Free Ammonia.
Litm.	Sharp	M_2O Boil.	M_2O Boil.	Met.-org. in cold gives total M_2O. Add excess of $BaCl_2$ to dilute cold solution of separate quantity and use Ph.-ph. without filtration. MHO only is indicated.	Tot. Alk. by Met.-org. on separate quantity. Add known MHO in excess to separate quantity, and determine MHO by $BaCl_2$ and Ph.-ph. in cold. The MHO which disappears converts $MHCO_3$ into M_2CO_3.	Good results.
Met.-org.	Sharp Cold	M_2O Cold	M_2O Cold			
Ph.-acet.						
Ph.-phth.	Sharp	M_2O Boil.	Neutral Cold, M_2O Boil.			Useless
Ros. acid.	Sharp	M_2O Boil.	M_2O Boil.			Fair

TABLE SHOWING INDICATIONS, ETC.—*continued.*

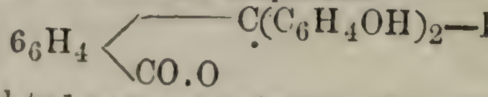
Indicator.	$M_2S_2O_3$.	M_2SO_3. $MHSO_3$.	M_2S.	M_3PO_4.	M_2HPO_4	M Silicate.	M Aluminate.	M Borates.	M_3AsO_4	$NaAsO_2$.
Litm.	Neutral	$\frac{1}{2}$ M_2O of M_2SO_3 ind. $MHSO_3$ neutral. Me.-org. best.	Good boiling	$\frac{2}{3}M_2O$ but Me.-org-sharpest, others indistinct. Ph.-ac. two changes.	$\frac{1}{2}M_2O$ Me.-org. sharpest.	Sharp.	High indistinct.	Indistinct.	Slow indistinct $\frac{2}{3}M_2O$	Good. Total M_2O indicated.
Met.-org.			Good cold			Sharp.	Sharp.	Good.	$\frac{2}{3}M_2O$	
Ph.-ac.			Good boiling			Indistinct.	Good.	Indistinct.	Same as litm.	
Ph.-phth.		M_2SO_3 neutral cold.	$\frac{1}{2}M_2O$ cold	$\frac{1}{3}M_2O$ cold	Almost neutral.	Low.		Useless.	$\frac{1}{3}M_2O$	Low.
Ros. acid.			M_2O boiling	$\frac{2}{3}M_2O$ indistinct.	$\frac{1}{2}M_2O$ indistinct.	Sharp boiling.	High.	Indistinct.	Same as litm.	Same as litm.

TABLE SHOWING INDICATIONS, ETC.—*continued.*

Indicator.	HCl, HNO_3 H_2SO_4.	$\left\{\begin{matrix}COHO\\COHO.\end{matrix}\right.$	$\left\{\begin{matrix}CH_3\\COHO.\end{matrix}\right.$	Tartaric Acid.	Citric Acid.	Remarks.
Litm.	Good boiling.	Sharp.	Low.	Fair.	Low.	Acids change blue to red; alkalies turn red to blue. Aq. soln.
Me.-org.	Good cold.	Useless.	Useless.	Useless.	Useless.	Yellow when alkaline; pink with acid; MCl, M_2SO_4, MNO_3 decrease sharpness; useless with nitrites. Alcoh. soln.
Ph.-ac.	Good if carb. present.	Low.	Low.	Low.		Faint yellow with MHO; dark pink with M_2CO_3 and NH_3, more intense with $MHCO_3$; golden yellow with acids. Alcoh. soln.
Ph.-phth.	Good boiling.	Sharp.	Sharp.	Good.	Sharp.	Colourless when acid or neutral; fine red when alkaline. Alcoh. soln.
Ros.-ac.	Good boiling.	Sharp.	Useless.	Fair.	Useless.	Pale yellow to pink by alkali; am. salts decrease sharpness. Alcoh. soln.

Phenacetolin.—Boil together for some hours phenol, acetic anhydride and sulphuric acid in equal molecular proportions, wash with water and dry. Dissolve 2 parts in 1000 alcohol (50 per cent.). It may be used *in the cold*, showing the whole of the base or acid in KHO, NaHO, AmHO, arsenites of these, mineral and oxalic acids; it may be used *boiling*, for carbonates, bicarbonates and sulphides.

Phenolphthalein,



$6_6H_4 \left\langle \begin{array}{l} C(C_6H_4OH)_2 \\ CO.O \end{array} \right.$ —Dissolve in 50 per cent. alcohol to 1 per cent. solution. Colourless in neutral and acid liquids, purple red with alkalies. Useless with ammonia except in alcoholic solution, and very sensitive to CO_2. It may be used in *the cold* for KHO, NaHO (not AmHO); mineral acids; oxalic, citric, tartaric, acetic and other organic acids. When *boiling* also for carbonates, bicarbonates and sulphides.

Rosolic Acid.—Dissolve in 50 per cent. alcohol to 0·2 per cent. solution. It is pale yellow in neutral and acid liquids, violet red with alkalies. Its delicacy is sensibly affected by ammonia and CO_2. It issued in *the cold* to determine the whole of the base in KHO, NaHO (AmHO), arsenites of these, mineral and oxalic acids; *boiling* it is used for carbonates, bicarbonates, sulphides, arsenites and silicates.

Lacmoid is prepared by gradually heating to 110° C., resorcin (100 parts), sodium nitrite (5 parts), water (5 parts), finally to 120° C. to expel ammonia; digesting the residue with water and precipitating with HCl. Dissolve in 50 per cent. alcohol to 0·2 solution. It resembles litmus, and is very useful in the form of lacmoid paper as a substitute for methyl orange in titrating coloured liquids. The table gives further information respecting indicators.

ANALYSIS BY SATURATION.

Normal Acid and Alkaline Solutions.

Normal Sodium Carbonate, N Na_2CO_3, 53 grams per litre. Dissolve pure, dry monocarbonate, prepared by igniting the bicarbonate to redness, in water, and make up to 1 litre.

$$\begin{aligned} 1\ \text{cm.}^3 &= \cdot 053\ \text{gram}\ Na_2CO_3 \\ &= \cdot 030\ \text{gram}\ CO_3 \\ &= \cdot 022\ \text{gram}\ CO_2. \end{aligned}$$

Normal Potassium Carbonate, N K_2CO_3, 69 grams per litre.—This cannot be made by direct weighing. Titrate a solution of unknown strength with N acid, and dilute accordingly.

Normal Sulphuric Acid, N H_2SO_4.—Dilute about 30 cm.^{3} of pure sulphuric acid (sp. gr. 1·840) to 1 litre; determine the strength of this solution by titration with N Na_2CO_3 and dilute accordingly. The strength may be checked by duplicate estimates of the acid gravimetrically with $BaCl_2$.

Normal Oxalic Acid, N $H_2C_2O_4$, 45 grams per litre; or 63 grams of – 2 aq.—This solution is best prepared by titrating a solution of unknown strength with N Na_2CO_3 and diluting. If required quickly, 63 grams of the crystallised (2 aq.) salt, dried by pressing between blotting paper, may be dissolved in water to 1 litre, but the result is uncertain.

Normal Hydrochloric Acid, N HCl, 36·37 grams per litre.—Take 181 grams of acid free from chlorine gas and chlorides, of sp. gr. 1·1, and dilute to 1 litre. Set by gravimetric estimation as AgCl, or by titration with N Na_2CO_3.

Normal Nitric Acid, N HNO_3, 63 grams per litre. —Make a solution stronger than is required, and set with N Na_2CO_3. The acid employed should be free from chlorine, and if it contains nitrous or hyponitrous acid it should be diluted with 2 volumes of water and boiled until white.

Normal Sodium Hydroxide (caustic soda) N NaHO, 40 grams per litre set with standard N acid.

Normal Potassium Hydroxide (caustic potash) N KHO, 56 grams per litre.—Take the caustic alkali made from metal, and dissolve to a solution of sp. gr. c. 1·05; determine the strength by titration with N acid, and methyl-orange in the cold.

Semi-normal Ammonia, $\frac{N}{2}$ NH_3, 8·5 grams per litre.—The solution is set by titration against N acid, with methyl-orange indicator, and diluting to the required extent. The solution must be checked from time to time.

Deci-normal Barium Hydroxide, $\frac{N}{10}$ BaH_2O_2, 17·1 grams per litre.—Prepare a saturated solution of the crystals (– 8 aq.) by shaking with water several days in a

TABLE FOR THE SYSTEMATIC ANALYSIS OF ALKALIES, ALKALINE EARTHS AND ACIDS.

Substance.	Formula.	Molecular Weight.	Quantity in grams to be weighed, so that 1 cm.³ of N Solution = 1 per cent. of Substance.	Normal Factor.
			Grams.	
Sodium oxide	Na_2O	62	3·1	·031
,, hydroxide ..	$NaHO$	40	4·0	·040
,, carbonate ..	Na_2CO_3	106	5·3	·053
,, bicarbonate	$NaHCO_3$	84	8·4	·084
Potassium oxide ..	K_2O	94	4·7	·047
,, hydroxide	KHO	56	5·6	·056
,, carbonate	K_2CO_3	138	6·9	·069
,, bicarbonate	$KHCO_3$	100	10·0	·100
Ammonia..	NH_3	17	1·7	·017
Ammonium carbonate.	$(NH_4)_2CO_3$	96	4·8	·048
Calcium oxide (lime)	CaO	56	2·8	·028
,, hydroxide..	CaH_2O_2	74	3·7	·037
,, carbonate ..	$CaCO_3$	100	5·0	·050
Barium hydroxide ..	BaH_2O_2	171	8·55	·0855
,, ,, crys.	BaH_2O_28aq	315	15·75	·1575
,, carbonate ..	$BaCO_3$	197	9·85	·0985
Strontium oxide ..	SrO	103·5	5·175	·05175
,, carbonate	$SrCO_3$	147·5	7·375	·07375
Magnesium oxide ..	MgO	40	2·00	·020
,, carbonate	$MgCO_3$	84	4·20	·042
Nitric acid	HNO_3	63	6·3	·063
Hydrochloric acid ..	HCl	36·37	3·637	·03637
Sulphuric ,, ..	H_2SO_4	98	4·9	·049
Oxalic ,, ..	$H_2C_2O_42aq$	126	6·3	·063
Acetic ,, ..	$H_4C_2O_2$	60	6·0	·060
Tartaric ,, ..	$H_6C_4O_6$	150	7·5	·075
Citric ,, ..	$H_8C_6O_7 + H_2O$	210	7·0	·070
Carbon dioxide ..	CO_2	44		·022

stoppered bottle; pour off the clear liquid, which will be nearly twice as strong as is required, titrate with $\frac{N}{10}$ acid and phenolphthalein, and dilute.

Normal Ammonio-cupric Solution.—Dissolve pure $CuSO_4$, 5 aq. in water, and add ammonia until the precipitate is nearly dissolved. Filter and titrate with N H_2SO_4 or N HNO_3. The end is reached when the last drop causes a permanent turbidity. The solution is of use in estimating free acid in presence of substances having themselves an acid reaction.

1 cm.³ of
Normal sodium carbonate, = ·053 gram Na_2CO_3
= ·030 gram CO_3 = ·022 gram CO_2.
Normal sulphuric acid, = ·049 gram H_2SO_4
= ·048 gram SO_4 = ·040 gram SO_3.
Normal oxalic acid, = ·063 gram $H_2C_2O_4, 2H_2O$
= ·045 gram $H_2C_2O_4$ = ·044 gram C_2O_4.
Normal hydrochloric acid, = ·0365 gram HCl
= ·0355 gram Cl.
Normal nitric acid, = ·063 gram HNO_3
= ·062 gram NO_3 = ·054 gram N_2O_5.
Normal sodium hydrate, = ·040 gram NaHO
= ·031 gram Na_2O = ·023 gram Na.
Normal potassium hydrate, = ·056 gram KHO
= ·047 gram K_2O = ·039 gram K.
Normal ammonium hydrate, = ·017 gram NH_3
= ·018 gram NH_4 = ·035 gram $(NH_4)HO$.

Note.—**Determination of Alkalies.**—The foregoing solutions are chiefly used for the estimation of alkalies, of alkalies in certain salts, and of acids. For the determination of alkaline hydroxides in absence of CO_2 and other disturbing substances, any indicator suffices to give a sharp end reaction. If CO_2 be present, good results are obtained by filtration with methyl-orange or lacmoid paper as indicators, the total alkali being indicated.

To determine alkaline carbonate when present in small proportion, a titration may be made with phenacetolin added in quantity sufficient to give a scarcely perceptible yellow. The standard acid is added, and when the tint changes from faint yellow to rose the caustic alkali is neutralised.

The volume of the standard acid used is noted, and the addition of acid is continued until the red tint changes to yellow; this indicates the decomposition of the carbonate. Phenolphthalein may be employed for the same determination. The point of the burette is submerged in the liquid under assay, and the change from pink to colourless indicates that the hydrate is neutralised and the carbonate transformed into bicarbonate. The burette is read off, and the titration is continued at a boiling heat to estimate this latter fraction of the total alkali. In both these methods it is preferable after obtaining the first indication to add a known excess of acid, boil off CO_2, and titrate back with N NaHo.

Another method depends upon the reaction

$$BaCl_2 + M'_2CO_3 = BaCO_3 + 2M'Cl.$$

A known volume of the liquid is titrated for total alkali, using methyl-orange. A similar volume is placed in a stoppered flask, and a solution of $BaCl_2$ added in just sufficient quantity to precipitate all the CO_2; the flask is filled up, shaken, stoppered, and allowed to settle. An aliquot part of the clear supernatant (not filtered) liquid is titrated. The alkalinity, which has apparently disappeared, represents the carbonate. If an excess of $BaCl_2$ be employed in this method, an error due to loss of caustic alkali occurs.

When bicarbonate is present in a solution under examination, there can of course be no caustic alkali present. In order to estimate the bicarbonate, a known excess of standard ammonia, free from carbonate, is added; this is followed by excess of $BaCl_2$, and titration of an aliquot part of the measured solution. The apparent loss of ammonia corresponds to the bicarbonate. Consider the $M'HCO_3$ as M'_2CO_3 and excess of CO_2. The M'_2CO_3 is decomposed by the $BaCl_2$ and its alkalinity apparently lost. The excess of CO_2 forms Am_2CO_3, which is decomposed and apparently lost; therefore after the subsidence of the $BaCO_3$, only the alkalinity of the excess of ammonia remains in solution. The subsidence of the precipitated BaC_3 in these methods is not necessary if the titration be carried out in the cold with phenolphthalein as indicator, since the BaC_3 has no effect on this indicator. The neutral sulphate and phosphate of barium have likewise no action on phenolphthalein, so that the alkali may be determined in presence of these. When sulphite is contained in the solution, it may be removed by addition of excess of (neutralised) hydrogen peroxide, heating to boiling cooling and titration. The soda or potash contained in silicates can be directly estimated with standard acid and methyl-orange.

For estimating the alkaline earths, the standard acid employed must be hydrochloric or nitric; this is added in excess, the CO_2 boiled off, and the excess of acid determined with standard alkali. Standard sodium carbonate may be used to determine Ca, Sr and Ba in neutral soluble salts; the indicator must be phenolphthalein, and as long as any of the Ca, &c. salts remain, the alkaline carbonate is decomposed as it falls in, with formation of a neutral salt of Na and $BaCO_3$, which does not affect the indicator. Immediately the whole of the Ca, &c. is precipitated, the pink tint appears.

Free ammonia is estimated with N and methyl-orange, and combined ammonia after distillation with excess of fixed caustic alkali. A known volume of standard acid is placed in the receiver; of this the ammonia distilling over, neutralises its equivalent, and the excess is found by titration.

The Determination of Acids.—The mineral acids are best titrated with standard alkali and methyl-orange. Phenolphthalein is the best indicator for acetic, oxalic, citric and tartaric acids; the standard caustic alkali should be free from CO_2.

For the indirect estimation of mixed Na + K salts see Indirect Analysis, p. 469.

TABLE FOR THE ESTIMATION OF MIXTURES OF SODIUM AND POTASSIUM CARBONATES BY TITRATION WITH NORMAL NITRIC ACID.

K_2CO_3. Na_2CO_3. Grams.		Cm.^{3} of Normal Acid.	K_2CO_3. Na_2CO_3. Grams.		Cm.^{3} of Normal Acid.
1·00 + ·00	require	14·47	·45 + ·55	require	16·89
·95 + ·05	,,	14·69	·40 + ·60	,,	17·11
·90 + ·10	,,	14·92	·35 + ·65	,,	17·33
·85 + ·15	,,	15·14	·30 + ·70	,,	17·55
·80 + ·20	,,	15·35	·25 + ·75	,,	17·76
·75 + ·25	,,	15·57	·20 + ·80	,,	17·97
·70 + ·30	,,	15·79	·15 + ·85	,,	18·19
·65 + ·35	,,	16·01	·10 + ·90	,,	18·40
·60 + ·40	,,	16·23	·05 + ·95	,,	18·62
·55 + ·45	,,	16·45	·00 + 1·00	,,	18·84
·50 + ·50	,,	16·67			

TABLE FOR APPROXIMATELY DETERMINING THE PROPORTION OF SODIUM AND POTASSIUM IN MIXED CHLORIDES.

2·71 grams of the pure, dry, mixed chlorides are dissolved in water and the solution made up to 100 cm.^{3} The chlorine in 10 cm.^{3} of this solution is then estimated by $\frac{N}{10}$ silver nitrate solution and chromate indicator.

Cm.^{3} $\frac{N}{10}$ Silver used.	Per cent. of NaCl.	Cm.^{3} $\frac{N}{10}$ Silver used.	Per cent. of NaCl.
36·3	0	39·3	30
36·4	1	39·8	35
36·5	2	40·3	40
36·6	3	40·8	45
36·7	4	41·3	50
36·8	5	41·8	55
37·3	10	42·3	60
37·8	15	42·8	65
38·3	20	43·3	70
38·8	25	43·8	75

TABLE FOR CONVERSION OF N INTO NH_3 AND ALBUMENOIDS.

($N \times 6·25 =$ albumenoids).

N.	NH_3.	Albumenoids.	N.	NH_3.	Albumenoids.
·1	·12	·63	·9	1·09	5·63
·2	·24	1·25	1·0	1·21	6·25
·3	·36	1·88	2·0	2·43	12·50
·4	·49	2·50	3·0	3·64	18·75
·5	·61	3·13	4·0	4·86	25·00
·6	·73	3·75	5·0	6·07	31·25
·7	·85	4·38	6·0	7·28	37·50
·8	·97	5·00	7·0	8·50	43·75

TABLE FOR CALCULATION OF RESULTS IN DETERMINATIONS OF N BY KJELDAHL'S METHOD, 1 GRAM OF SUBSTANCE USED.

$$1 \text{ cm.}^3 \frac{N}{5} \text{ acid} = \cdot 002802 \text{ gram N} = \cdot 003402 \text{ gram } NH_3.$$

No. of cm.$^3 \frac{N}{5}$ acid used.	Per cent. of N.	Per cent. of NH_3.	No. of cm.$^3 \frac{N}{5}$ acid used.	Per cent. of N.	Per. cent. of NH_3.	No. of cm.$^3 \frac{N}{5}$ acid used.	Per cent of N.	Per cent. of NH_3.
1	0·28	0·34	21	5·88	7·14	41	11·48	13·94
2	0·56	0·68	22	6·16	7·48	42	11·76	14·28
3	0·84	1·02	23	6·44	7·82	43	12·04	14·62
4	1·12	1·36	24	6·72	8·16	44	12·32	14·96
5	1·40	1·70	25	7·00	8·50	45	12·60	15·30
6	1·68	2·04	26	7·28	8·84	46	12·88	15·64
7	1·96	2·38	27	7·56	9·18	47	13·16	15·98
8	2·24	2·72	28	7·84	9·52	48	13·44	16·32
9	2·52	3·06	29	8·12	9·86	49	13·72	16·66
10	2·80	3·40	30	8·40	10·20	50	14·01	17·01
11	3·08	3·74	31	8·68	10·54	51	14·29	17·35
12	3·36	4·08	32	8·96	10·88	52	14·57	17·69
13	3·64	4·42	33	9·24	11·22	53	14·85	18·03
14	3·92	4·76	34	9·52	11·56	54	15·13	18·37
15	4·20	5·10	35	9·80	11·90	55	15·41	18·71
16	4·48	5·44	36	10·08	12·24	56	15·69	19·05
17	4·76	5·78	37	10·36	12·58	57	15·97	19·39
18	5·04	6·12	38	10·64	12·92	58	16·25	19·73
19	5·32	6·46	39	10·92	13·26	59	15·53	20·07
20	5·60	6·80	40	11·20	13·60	60	16·81	20·41

Cm.$^3 \frac{N}{5}$ acid	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
Per cent. of N	·03	·06	·08	·11	·14	·17	·20	·22	·25
Per cent. of NH_3	·03	·07	·10	·14	·17	·20	·24	·27	·31

$\log. \cdot 002802 = \bar{3} \cdot 4474681.$

$\log. \cdot 003402 = \bar{3} \cdot 5317343.$

ANALYSIS BY OXIDATION.

Deci-normal Potassium Permanganate, $\frac{N}{10}$

$MnKO_4$, 3·156 grams per litre. Dissolve to 1 litre, check the titre with pure iron (flower wire) or with oxalic acid (·1125 gram = 1 gram Fe) with ferrous ammonium sulphate (·7 gram = ·1 gram Fe), or with hydrogen peroxide in the nitrometer.

1 cm.³ $\frac{N}{10}$ $KMnO_4$ is =

·0056	gram	Fe″		
·0072	,,	FeO		
·008	,,	Fe_2O_3 estimated as Fe″		
·003733	,,	Fe from FeS		
·0059	,,	Sn	,,	$SnCl_2$
·00295	,,	Sn	,,	SnS_2
·00315	,,	Cu	,,	CuS
·00274	,,	Mn	,,	MnS
·00315	,,	Cu	,,	$Cu + Fe_2Cl_6$
·0063	,,	Cu	,,	CuO + Fe
·0017	,,	H_2S		
·0008	,,	O		
·0063	,,	$H_2C_2O_42aq$		
·002	,,	Ca from CaC_2O_4		
·0120	,,	U	,,	UO.

Deci-normal Potassium Bichromate, $\frac{N}{10}$ $K_2Cr_2O_7$

Cr_2O_7, 4·913 grams per litre.—The required quantity of the pure salt dried by gentle ignition is dissolved to 1 litre.

1 cm.³ = ·004913 gram $K_2Cr_2O_7$

·0056	,,	Fe″
·0072	,,	FeO
·0127	,,	I
·0069	,,	Pb

Deci-normal Iodine, $\frac{N}{10}$ I, 12·7 grams per litre.—

Dissolve pure dry I together with c. 18 grams KI, free from iodate, to 1 litre. Verify the solution by titration with pure $Na_2S_2O_3$. For value of 1 cm.³ see $\frac{N}{10}$ $Na_2S_2O_3$ (next page).

Deci-normal Sodium Thiosulphate, $\frac{N}{10}$ Na_2S_2

O_3, 5aq, 24·827 grams per litre.—Dissolve the required quantity of the pure salt to 1 litre. The salt is purified by washing the coarsely powdered pure crystals first with alcohol and then with ether, and drying in a current of air.

The solution should be tested against $\frac{N}{10}$ I, of which 1 cm.^{3} = 1 cm.^{3}

1 cm.^{3} = ·0127 gram I
·0158 „ $Na_2S_2O_3$
·0248 „ $Na_2S_2O_3$, 5aq
·00495 „ As_2O_3
·00575 „ As_2O_5.

Deci-normal Alkaline Arsenite, $\frac{N}{10}$ As_2O_3

4·95 grams per litre.—Dissolve the purest sublimed arsenious oxide, in the form of powder, in about 250 cm.^{3} water, with about 20 grams of pure Na_2Co_3, cool, make up to 1 litre.

The solution is checked against $\frac{N}{10}$ I.

1 cm.^{3} = ·0127 gram. I = ·003537 Cl.

Note.—The use of the foregoing solutions depends upon oxidation. Standard permanganate solution is decomposed by organic matter (e.g. paper), and should be kept in the dark in bottles covered with black paper, and verified from time to time. It is always used in the presence of sulphuric acid; or of hydrochloric acid in dilute solution after addition of several grams of manganous or magnesium sulphate. It is largely used in estimating iron, which is first reduced to the Fe″ condition by pure Zn or Mg. The end of the reaction is known by the permanence of the pink tint.

Standard $K_2Cr_2O_7$ is also largely used for estimations of iron, which is best reduced with $SnCl_2$ followed by $HgCl_2$ (to decompose the slight excess of the tin salt), or by an alkaline sulphite. The external indicator is very dilute potassium ferricyanide solution, free from ferrocyanide and freshly dissolved.

The indicator for use with standard iodine is internal. It is *starch solution* made as follows:—Pour 200 parts of boiling water upon 1 part of starch previously ground to a thin paste with a few drops of cold water; allow to settle and decant the clear liquid: or dissolve 1 gram of soluble starch in the same amount of hot water and cool. Standard thiosulphate is of great use for estimating the "available" oxygen in certain substances which yield Cl when boiled with HCl. The Cl is passed into KI and the liberated I titrated with the thiosulphate and starch as indicator.

ANALYSIS BY PRECIPITATION.

Deci-normal Silver Nitrate, $\frac{N}{10}$ $AgNO_3$, 10·766 grams Ag, or 16·966 grams Ag NO_3, per litre.—Dissolve the Ag in slight excess of dilute nitric acid gently heated, and dilute to 1 litre; or if a solution free from excess of acid be required, dissolve the silver nitrate to 1 litre.

$$1 \text{ cm.}^3 = {\cdot}010766 \text{ gram Ag} = {\cdot}016966 \text{ gram } AgNO_3$$
$$= {\cdot}003537 \text{ gram Cl.}$$

Deci-normal Sodium Chloride, $\frac{N}{10}$ NaCl, 5·837 grams per litre.—Dissolve the pure salt to 1 litre.

$$1 \text{ cm.}^3 = {\cdot}0058378 \text{ gram NaCl}$$
$$= {\cdot}003537 \quad \text{,,} \quad \text{Cl}$$
$$= {\cdot}010766 \quad \text{,,} \quad \text{Ag.}$$

Deci-normal Alkaline (Am or K) Thiocyanate, $\frac{N}{10}$ M′CNS.—Dissolve about 8 grams of the Am, or 10 grams of the K salt, to 1 litre, and adjust by titration against $\frac{N}{10}$ $AgNO_3$.

NOTE.—The estimation of Cl by means of $\frac{N}{10}$ $AgNO_3$ is performed in neutral or very faintly alkaline solution, and the standard silver solution must contain no free acid. The (internal) indicator is K_2CrO_4, and the appearance of the blood-red tint indicating the end of the titration is most easily seen in gas light. When standard thiocyanate is used for the titration of silver, the process is carried out in the cold with a ferric salt as indicator: a saturated solution of iron alum is convenient.

STANDARD SOLUTIONS AND FACTORS FOR SPECIAL PURPOSES.

Aluminium (Baeyer).—Estimated by mixing with excess of sodium acetate and excess of $\frac{N}{10}$ phosphate, heating to boiling, without filtration; titrating the excess of phosphate with standard uranium $\frac{N}{10}$. Ammonium-Sodium Phosphate 20·9 grams per litre.

$$1 \text{ cm.}^3 = \cdot 00513 \text{ gram } Al_2O_3.$$

Antimony.—1. (Mohr.) The tartrate solution is neutralised by Na_2CO_3, excess of $NaHCO_3$ added, and the titration performed with $\frac{N}{10}$ I and starch. 1 cm.³ = ·0060 gram Sb.

2. (Kesslor.) A solution of Sb_2O_3, containing between one-sixth and one-third of its volume of HCl (sp. gr. 1·12), is titrated with $K_2Cr_2O_7$. This is set against a solution of As_2O_3 (5 grams), dissolved in NaHO, neutralised with HCl, 100 cm.³ concentrated HCl added, and made up to 1 litre. Excess of $K_2Cr_2O_7$ is added to 10 cm.³ As_2O_3 solution, which has been mixed with 20 cm.³ HCl (sp. gr. 1·12) and c. 90 cm.³ water, and the excess of $K_2Cr_2O_7$ is determined with a solution of $FeSO_4$ previously set against the $K_2Cr_2O_7$, the indicator being the usual $K_6Fe_2Cy_{12}$. The actual titration of the Sb_2O_3 is performed as with the As_2O_3. 1 cm.³ standard As_2O_2 solution (as above) = ·005 gram As_2O_3 = ·007253 gram Sb_2O_3.

Arsenic.—1. (Mohr.) Estimated by mixing neutral solution of As_2O_3 with excess of $NaHCO_3$, and titrating with $\frac{N}{10}$ I and starch.

2. (Platten.) As_2S_3 is boiled with pure water for some hours until the solution is colourless, and the As_2O_3 titrated with $\frac{N}{100}$ I solution. This process is useful for the determination of the As_2S_3 separated from metals, alloys, ores, &c. by distillation with HCl and Fe_2Cl_6.

3. (Kessler.) The method of oxidation with $K_2Cr_2O_7$ is described under ANTIMONY.

4. (Bunsen.) Another method depends upon the apparent loss of available oxygen, when As_2O_3 is dissolved with excess of potassium bichromate and HCl.

$$4 \text{ eq. Cl} = 2 \text{ eq. O} = 1 \text{ eq. } As_2O_3.$$

5. (Pearce.) Another method is to fuse the arsenical substance with $Na_2CO_3 + KNO_3$, extract with water, acidify with HNO_3, boil off CO_2 and nitrous fumes, make very feebly ammoniacal, precipitate with neutral $AgNO_3$, and wash the Ag_3AsO_4. The Ag in the precipitate is estimated by dissolving in KNO_3

and titration with ammonium-thiocyanate and ferric indicator (*vide supra*). Sb if present does not interfere.

6. (Williamson.) Mix arseniate with HKI and excess of HCl, titrate I with $\frac{N}{10}$ $Na_2S_2O_3$ in strong solution, dilute, neutralise and titrate As_2O_3 with $\frac{N}{10}$ I as a check.

7. In presence of $SnCl_2$ titrate this with $Na_2S_2O_3$ in strong acid solution, add Rochelle salt, neutralise, and titrate As_2O_3 in alkaline solution.

Barium may be estimated by titration with standard $K_2Cr_2O_7$ in presence of ammonia, free from carbonate, at 60°–70° C. The appearance of yellow in the supernatant liquid indicates the end. Standard $K_2Cr_2O_7$, 7·37 grams per litre. 1 cm.^{3} = ·00684 gram Ba. This is a $\frac{N}{10}$ solution for *precipitational* purposes as distinct from the oxidational solution.

Bismuth. (Muir and Robbs.)—Bi, first separated from mixtures as oxychloride, is dissolved in HNO_3 and reduced to the smallest excess of acid by evaporation. The solution is made up with a large excess of acetic acid, and an aliquot part taken. N potassium oxalate is added in small excess, and the excess of oxalate estimated by titration with $KMnO_4$. The Bi precipitate is $Bi_2(C_2O_4)_3$, $K_2C_2O_4$.

2. (Muir.) Bi in a nitric solution free from HCl may be volumetrically determined by adding excess of sodium acetate, then a measured excess of sodium phosphate (35·8 grams per litre; 1 cm.^{3} = ·0071 gram P_2O_5), and the phosphate remaining in the filtrate formed with standard uranium.

Cadmium. For determination as oxalate, see Zinc, p. 432.

Calcium is estimated by titration of the washed oxalate with $\frac{N}{10}$ permanganate, or by precipitating as oxalate, and finding the excess of oxalate in the filtrate.

$$1\ \text{cm.}^3\ \frac{N}{10}\ KMnO_4 = \cdot 0028\ \text{gram}\ CaO = \cdot 0050\ \text{gram}\ CaCO_3$$
$$= \cdot 0086\ \text{gram}\ CaSo_4,\ 2aq.$$

1 cm.^{3} N oxalic acid = ·0280 gram CaO.
Crystallised oxalic acid × ·444 = CaO.
$FeAm_2(SO_4)_2$, 6aq × ·07143 = CaO.

Chlorine.—Free Cl is passed into KI, and the liberated I titrated with $\frac{10}{N}$ thiosulphate and starch, or with $\frac{N}{10}$ As_2O_3 and starch-paper. Cl in neutral solution *vide* p. 417. For bleaching powder, dissolve 7·917 grams to 250 cm.³, decompose 10 cm.³ in a (50 cm.³) nitrometer with H_2O_2 in excess. Each cm.³ of O evolved = 1 per cent. "available" Cl. When chlorides, hypochlorite and chlorate are present (Carnot), titrate with $\frac{N}{10}$ alkaline arsenite for M′ClO until no blue tint appears with KI + starch (external); acidulate with H_2SO_4, and add a large excess of $FeAm_2(SO_4)_2$ 6aq, heat to 100° in a closed vessel, and add in drops 5 cm.³ of dilute (1 in 15) H_2SO_4, cool, and determine Fe″ with $KMnO_4$ to estimate $M'ClO_3$; remove pink tint with a trace of Fe″ salt, add excess of $\frac{N}{10}$ $AgNO_3$, and determine excess of Ag with thiocyanate, the iron present serving as indicator; this gives total Cl.

Chromium.—Estimated as chromate by adding excess of Fe″ solution, and determining the excess with $\frac{N}{10}$ $K_2Cr_2O_7$.

$$Fe \times 3119 = Cr.$$

Copper.—1. (Schwarz.) Estimated by precipitating from alkaline tartrate solution with grape sugar at below 90° C., washing, dissolving the Cu_2O in H_2SO_4 in presence of Fe_2Cl_6 in excess, and determining the Fe″ produced by titration with $\frac{N}{10}$ $KMnO_4$; or (Fleitman) the Cu is precipitated with Zn (in absence of nitric acid, Bi, or Pb) washed, dissolved in Fe_2Cl_6 and HCl, and the Fe″ determined. 56 Fe = 31·5 Cu.

2. (Brown.) Mix with KI in acid solution, and determine the liberated I with $\frac{N}{10}$ $Na_2S_2O_3$ (1 cm.³ = ·0063 gram Cu) and starch.

3. (Parkes and Mohr). After precipitation with Zn or H_2S, bring into solution with nitric acid, add slight excess of Na_2CO_3 and 1 cm.³ strong AmHO (·880); titrate with standard KCN. The disappearance of the blue gives the end. The KCN is set with pure Cu under same conditions. Varying quantity of ammonia or its salts causes errors.

4. (Pelouze.) Precipitate from ammoniacal solution with standard sodium sulphide at 40°–80° C., or from acid solution with same. This standard is set every day against pure Cu.

$$1\ cm.^3\ \frac{N}{10}\ solution = \cdot0063\ gram\ Cu$$

$$Fe \times 1\cdot125 = Cu$$

$$FeAm_2(SO_4)_2,\ 6aq \times \cdot1607 = Cu.$$

Cyanides.—1. (Liebig.) By titration with $\frac{N}{10}$ Ag NO_3 in alkaline solution, KCN, AgCN is formed, the end being known by appearance of turbidity. Dissolve 1·3 gram commercial KCN for analysis, then 1 cm.^{3} $\frac{N}{10}$ Ag = 1 per cent. KCN.

2. (Hannay.) By titrating with $HgCl_2$ in presence of ammonia. Standard $HgCl_2$, 13·537 grams per litre, 1 cm.^{3} = ·0026 gram CN = ·00651 gram KCN.

3. (Fordos and Gelis.) Titrate with $\frac{N}{10}$ I until permanance of yellow tint.

1 cm.^{3} $\frac{N}{10}$ Ag solution = ·0052 gram CN = ·0054 gram HCN
= ·01302 gram KCN

1 cm.^{3} $\frac{N}{10}$ I solution = ·003253 gram KCN.

4. (Vielhaber). Dilute solutions of HCN made slightly alkaline with MgO may be titrated with $\frac{N}{10}$ $AgNO_3$ and chromate (*vide* CHLORIDE, p. 417). . . . **Ferrocyanide** can be estimated (De Haen) by titration with $\frac{N}{10}$ $KMnO_6$.

$$1 \text{ cm.}^3 \frac{N}{10} KMnO_4 = \cdot 0422 \text{ gram } K_4Fe(CN)_6, 3aq.$$

$$Fe \times 7 \cdot 541 = K_4Fe(CN)_6, 3aq$$

$$FeAm_2(SO_4)_2, 6aq \times 1 \cdot 077 = K_4Fe(CN)_6, 3aq.$$

Ferricyanide.—1. Reduce to ferrocyanide by boiling with NaHO and adding $FeSO_4$ until precipitation becomes blackish, make up to a convenient measure, an aliquot part is filtered, made acid with H_2SO_4, and titrated with $\frac{N}{10}$ $KMnO_4$. Reduction may be effected (Kassner) with Na_2O_2 or NaHO + H_2O_2, boiling, acidulating with H_2SO_4, and titration with $\frac{N}{10}$ $KMnO_4$.

2. (Lenssen, Mohr.) Mix with KI and HCl, add excess $ZnSO_4$; after a few minutes add slight excess of Na_2CO_3, and titrate free I with $\frac{N}{10}$ $Na_2S_2O_3$ and starch. 1 cm.^{3} $\frac{N}{10}$ $Na_2S_2O_3$ = ·0329 gram $K_6Fe_2(CN)_{12}$.

$\frac{N}{10}$ $Na_2S_2O_3$, 1 cm.³ = ·0329 gram $Fe_2K_6(CN)_{12}$

$Fe \times 5{\cdot}88 = Fe_2K_6(CN)_{12}$

$FeAm_2(SO_4)_2, 6aq \times 1{\cdot}68 = Fe_2K_6(CN)_{12}$.

Thiocyanate of alkali or alkaline earth (Barnes and Lidobe) is mixed with $NaHSO_3$ solution (sp. gr. 1·3), boiled, and standard $CuSO_4$ added until a brown coloration appears with $K_4Fe(CN)_6$ solution (1 in 20) used as external indicator.

Standard $CuSO_4$, 5 aq 6·2375 gram per litre, 1 cm.³ = ·00145 gram SCN.

Glycerol.—(A. H. Allen.) Oxidation with $KMnO_4$ to oxalic acid, precipitation with Ca and titration with $\frac{N}{10}$ $KMnO_4$. For fats: saponify 10 grams fat with 4 grams pure KHO and 25 cm.³ water (from 6 to 10 hours required). Decompose with acid, filter off, dilute filtrate to c. 400 cm.³, add 10–12 grams KHO and excess of saturated solution of $KMnO_4$,* boil for 1 hour, destroy violet or green colour with Na_2SO_3, filter hot, make up with hot water to 515 cm.³, filter, take 400 cm.³ of cooled filtrate and precipitate with $CaCl_2$ in presence of acetic acid, wash precipitate, dissolve in dilute H_2SO_4, and titrate with $\frac{N}{10}$ $KMnO_4$ (1 cm.³ = ·0046 gram glycerol).

Gold.—Mix $AuCl_3$ with measured N oxalic acid, and determine the oxalic acid left after 24 hours by titration with $\frac{N}{10}$ $KMnO_4$. 1 cm.³ N oxalic acid = ·0655 gram Au.

Iodine.—1. Distil iodides with HCl and iron alum into receiver containing KI, and titrate free I in distillate with $\frac{N}{10}$ $Na_2S_2O_3$ and starch.

2. (Cook.) In presence of chloride or bromide, or both, liberate I with H_2O_2 in presence of acetic acid; after 1 hour extract with chloroform, wash with water, and titrate with $\frac{N}{10}$ $Na_2S_2O_3$.

3. (Reinige.) $\frac{N}{10}$ $KMnO_4$ is added to iodide, which must be of alkali or alkaline earth, and made alkaline with Na_2CO_3,

* Mangold oxidises in the cold and destroys excess of $KMnO_4$ with H_2O_2.

until supernatant liquid is pink; solution is diluted to known measure, allowed to settle, and excess of $KMnO_4$ determined by titration of aliquot part with $\frac{N}{10}$ $Na_2S_2O_3$. 1 cm.^{3} $\frac{N}{10}$ $KMnO_4$ = ·0127 gram I.

4. (Pisani.) The liquid containing iodide is titrated with $\frac{N}{10}$ $AgNO_3$ and starch iodide as indicator. Chlorides and bromides do not interfere, because they do not react with $AgNO_3$ until the free I causing the blue tint disappears. Free I by $\frac{N}{10}$ $Na_2S_2O_3$ and starch, *vide* p. 416.

Iron.—Estimated with $\frac{N}{10}$ $K_2Cr_2O_7$ or $\frac{N}{10}$ $KMnO_4$ (*vide* p. 415). Other methods are titration with $SnCl_2$ and $Na_2S_2O_3$.

Lead.—1. (Hempel.) By precipitating with excess of N oxalic acid and determining the excess.

2. (Schwarz.) By precipitating as chromate, washing, and dissolving precipitate in known amount of Fe″ solution acid with HCl; the excess of Fe′ is determined with $KMnO_4$. It is better to add excess of standard $K_2Cr_2O_7$, and determine excess after filtration with standard Fe″ solution.

1 cm.^{3} $\frac{N}{10}$ $KMnO_4$ = ·01032 gram Pb
1 cm.^{3} N oxalic acid = ·1032 gram Pb
Fe × 1·846 = Pb
$FeAm_2(SO_4)_2$, 6aq × ·263 = Pb.

Manganese.—1. (Pattinson). By precipitation as MnO_2 from a HCl solution, by $CaCO_3$ and Cl or Br in presence of a ferric salt or zinc salt, and dissolution of the MnO_2 in presence of a known excess of Fe″ when the Fe″ oxidised is a measure of the Mn.

2. (Guyard.) By titration with $\frac{N}{10}$ $KMnO_4$ at c. 80° C. in neutral solutions until the supernatant liquid is tinted.

Fe × ·491 = Mn
Fe × ·63393 = MnO
Fe × ·7768 = MnO_2
$FeAm_2(SO_4)_2$, 6aq × ·0911 = MnO
" " × ·111 = MnO_2
$H_2C_2O_4$, 2aq × ·6916 = MnO_2.

Mercury.—1. The metal being all present as Hg′, excess of $\frac{N}{10}$ NaCl solution is added in the cold, the precipitate filtered off and washed, and the excess of NaCl determined with $\frac{N}{10}$ $AgNO_3$ and chromate indicator.

2. (Mohr.) Hg″ in solution, in absence of HNO_3, free Cl, &c., is mixed with $FeAm_2(SO_4)_2$, 6aq, and then excess of NaHO added. After being well shaken for some minutes, NaCl + H_2SO_4 are added, and the shaking continued until the precipitated HgCl is white; the solution is made up, filtered, and an aliquot portion titrated with $\frac{N}{10}$ $KMnO_4$ to determine Fe remaining as Fe″. The Fe″ oxidised is a measure of the Hg″.

3. (Hempel.) Hg′ is precipitated as HgCl, the precipitate washed, and shaken with KI and excess of $\frac{N}{10}$ I, the mixture made up, and the excess of I in an aliquot portion determined with $\frac{N}{10}$ $Na_2S_2O_3$ and starch.

4. (Personne.) $\frac{N}{10}$ KI, 33·2 grams per litre, 1 cm.³ = ·01 gram, Hg = ·01355 gram $HgCl_2$, $\frac{N}{10}$ $HgCl_2$ = 13·537 grams per litre. Dissolve to 1 litre with 30 grams NaCl. 1 cm.³ = ·01 gram Hg. The second solution is required for setting this $\frac{N}{10}$ KI. Run the solution of $HgCl_2$ under assay into a measured volume of the $\frac{N}{10}$ KI, with stirring until a permanent red precipitate forms.

1 cm.³ $\frac{N}{10}$ solution = ·0200 gram Hg′
= ·0208 gram Hg_2O
= ·0271 gram $HgCl_2$
= ·003349 gram CrO_3
= ·00492 gram $K_2Cr_2O_7$
Fe × 3·5728 = Hg
Fe × 4·8398 = $HgCl_2$
$FeAm_2(SO_4)_2$,6aq × ·5104 = Hg
" × ·6914 = HCl_2.

Nickel.—(Moore.) When an ammoniacal solution of Ni, containing as indicator a little suspended AgI, is titrated below 20° C. with KCN, the turbidity disappears with the slightest excess of KCN. Standard KCN 22 to 25 grams per litre. This is run into the Ni until the last drop clears the liquid. Set the KCN against pure Ni, against Ag, or $NiSO_4$, or Ag × 27190 = Ni.

Nitrates.—1. (Gay Lussac, Abel.) Alkaline nitrates ignited with C become M'_2CO_3, which is titrated with standard acid.

2. Distil the nitrate with H_2SO_4, preferable under reduced pressure (Finkeuner), and titrate acid filtrate with standard alkali.

3. (Schulze and Vernon Harcourt.) By heating with caustic soda solution and Fe + Zn, when NH_3 is formed and distils over, and is estimated by titration.

4. By heating the nitrate with HCl and excess Fe″ in atmosphere of H or CO_2 (Pelouze-Fresenius). The Fe″ remaining is titrated with $\frac{N}{10}$ $K_2Cr_2O_7$. Fe oxidised × ·375 = HNO_3.

5. (Schlösing.) By the reaction between Fe″ salts in solution with nitrates, when NO is evolved and either measured or oxidised to HNO_3 and titrated.

6. In the nitrometer, 1 cm.³ NO at 0° C., and 760 m.m. = ·001343 gram, NO = ·001701 gram, N_2O_3 = ·002417 gram, N_2O_5 = ·004521 gram, KNO_3 = ·003805 gram $NaNO_3$.

$$
\begin{aligned}
\text{N acid} &\times \cdot0540 = N_2O_5\\
\text{,,} \quad &\times \cdot1011 = KNO_3\\
\text{Fe} \quad &\times \cdot3750 = HNO_3\\
\text{,,} \quad &\times \cdot6018 = KNO_3\\
\text{,,} \quad &\times \cdot3214 = N_2O_5.
\end{aligned}
$$

Nitrites.—1. (Dunstan and Dymond.) By adding, in absence of free O, nitrite to KI solution acidulated with H_2SO_4, and estimating liberated I.

2. Kinnicut and Nef.) Dissolve in cold water (1 to 300) add $\frac{N}{10}$ $KMnO_4$ drop by drop until pink, add 3 drops diluted H_2SO_4, then known excess of $\frac{N}{10}$ $KMnO_4$, boil, and determine excess of $KMnO_4$ with $\frac{N}{10}$ oxalic acid.

1 cm.³ $\frac{N}{10}$ $KMnO_4$ = ·0345 gram $NaNO_2$ = ·0425 gram KNO_2.

OXYGEN DISSOLVED BY DISTILLED WATER 5°–30° C.
(Roscoe and Lunt.)

Temp. °C.	cm.^{3} Oxygen per litre, 0° C. 760 m.m.*	Diff. for 5° C.	Temp. °C.	cm.^{3} Oxygen per litre, 0° C., 760 m.m.*	Diff. for 5° C.
5·0	8·68	·10	18·0	6·54	·07
5·5	8·58	·09	18·5	6·47	·07
6·0	8·49	·09	19·0	6·40	·06
6·5	8·40	·09	19·5	6·34	·06
7·0	8·31	·09	20·0	6·28	·06
7·5	8·22	·09	20·5	6·22	·06
8·0	8·13	·09	21·0	6·16	·06
8·5	8·04	·09	21·5	6·10	·06
9·0	7·95	·09	22·0	6·04	·05
9·5	7·86	·09	22·5	5·99	·05
10·0	7·77	·09	23·0	5·94	·05
10·5	7·68	·08	23·5	5·89	·05
11·0	7·60	·08	24·0	5·84	·04
11·5	7·52	·08	24·5	5·80	·04
12·0	7·44	·08	25·0	5·76	·04
12·5	7·36	·08	25·5	5·72	·04
13·0	7·28	·08	26·0	5·68	·04
13·5	7·20	·08	26·5	5·64	·04
14·0	7·12	·08	27·0	5·60	·03
14·5	7·04	·08	27·5	5·57	·03
15·0	6·96	·08	28·0	5·54	·03
15·5	6·89	·07	28·5	5·51	·03
16·0	6·82	·07	29·0	5·48	·03
16·5	6·75	·07	29·5	5·45	·03
17·0	6·68	·07	30·0	5·43	—
17·5	6·61	·07			

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* Deduct $\frac{1}{76}$th of value in this column for every 10 m.m. of observed pressure below 760 m.m., and add $\frac{1}{76}$th for every 10 m.m. above 760 m.m.

3. (P. Frankland.) By measuring the N evolved when a nitrite is mixed with urea and sulphuric acid (1 in 5), the experiment is carried out in a Crum-Frankland tube or a nitrometer, and the N measured after removal of CO_2 with NaHO. ($2CO(NH_2)_2 + N_2O_3 = CO(NH_4O)_2 + CO_2 + 2N_2$).

Oxygen.—1. (Schützenberger, Roscoe and Lunt.) Oxygen in water can be estimated with standard sodium hyposulphite, Na_2SO_2, with reduced indigo carmine as indicator.

Standard Na_2SO_2.—Dissolve 125 grams $NaHSO_3$ in 250 cm.^{3} water, and saturate with SO_2, reduce with 50 grams good zinc dust in a 500-cm.^{3} bottle, nearly fill bottle with water, shake 5 minutes, cool under tap, shake again after 15 minutes, allow to settle, decant into half-gallon bottle half filled with water, add milk of lime in excess, fill up bottle and allow to settle. The above is a stock solution, and must be diluted with precautions to avoid undue contact with air until 5 cm.^{3} are required to titrate 100 cm.^{3} ordinary tap water.

Standard Aerated Distilled Water.—Half-gallon bottles are half filled with freshly distilled water and shaken with the superincumbent air for 5 minutes, the air is renewed by filling up one bottle, then decanting into the other. The water is then divided between the bottles and shaken again, the temperature °C. of water and barometric pressure in m.m. recorded, and the bottles stoppered and allowed to stand.

Indigo-carmine Solution.—Shake 200 grams indigo carmine in a half-gallon bottle, filter, dilute until 20 cm.^{3} require c. 5 cm.^{3} standard hyposulphite.

The titration is performed in a special apparatus as follows: Place in a small bottle 20 cm.^{3} of the water under examination and 3 cm.^{3} indigo solution; pass hydrogen through a very fine jet for three minutes to expel O from water and bottle space; add hyposulphite (standardised against aerated distilled water) until the change from blue to yellow occurs, avoiding slightest excess; add excess of hyposulphite (say 10 cm.^{3}); titrate with the water under examination, adding this quickly through a capillary tube *with point submerged*, until permanent blue tint appears; add the (slight) amount of hyposulphite required to decolorise. This amount added to the second amount (say 10 cm.^{3}) is a measure of the oxygen.

2. (Thresh.) Cause the free oxygen dissolved in a water to liberate I from KI, a little nitrous acid being present to act

as a carrier between the oxygen and the KI. The solutions required are:—

(1)	$NaNO_2$	·5 gram
	KI	20 grams
	Water	100 cm.^{3}
(2)	Pure H_2SO_4	1 part
	Water	3 parts.
(3)	Clear starch freshly prepared.	
(4)	Standard $Na_2S_2O_3$ 7·75 grams per litre	

1 cm.^{3} = ·00025 gram.

The titration is carried out in a special apparatus in an atmosphere of coal gas.

3. (Kingzett.) Hydrogen peroxide is assayed by titrating the I liberated when the peroxide is mixed with KI and a large excess of H_2SO_4; 1 cm.^{3} $\frac{N}{10}$ $Na_2S_2O_3$ = ·0017 gram H_2O_2 = ·0016 gram O: or by titration with $KMnO_4$ (2·625 grams per litre) using 5 cm.^{3} of H_2O_2. 1 cm.^{3} $K_2MnO_4 \div 10$ = the volume of O liberated by 1 cm.^{3} H_2O_2.

Sodium peroxide (Archbutt) is assayed in the nitrometer, a few mg. of cobalt peroxide (Co_3O_5, xaq) being used to promote decomposition. The volume of O liberated is the oxygen available in the H_2O_2.

Phosphoric Acid.—1. (Sutton.) By precipitation as $U_2P_2O_8$ by means of standard uranium solution.

Standard Uranium Solution.—1 cm.^{3} = ·005 gram P_2O_5 = ·0066 gram PO_4. Dissolve c. 35 grams uranium acetate or nitrate in water, add c. 50 cm.^{3} glacial acetic acid, and make up to 1 litre. The solution is then titrated against the standard phosphate, and diluted until 20 cm.^{3} = 50 cm.^{3} of the latter.

Standard Phosphate Solution.—Dissolve 3·83 grams of dihydric potassic phosphate, KH_2PO_4, to 1 litre. 50 cm.^{3} = ·1 gram P_2O_5.

Solution of Sodium Acetate.—Dissolve 100 grams with 50 cm.^{3} glacial acetic acid to 1 litre. Only required when uranium nitrate is used.

Indicator.—Freshly prepared solution of $K_4Fe(CN)_6$. The P_2O_5 is brought into aqueous solution, and 1 cm.^{3} of 10 per cent. (sp. gr. ·96) ammonia added, neutralised with acetic acid, and diluted to c. 50 cm.^{3}, heated to 96° C., and titrated with standard uranium until the (external) indicator shows a slight brown tint. The process requires uniform conditions in standardising and titrating. For estimating P_2O_5 in combination with Ca the uranium is standardised gravimetrically against $Ca_3P_2O_8$ dissolved in acetic acid, and nearly all of it added in the cold, and the titration finished at 90° C. The uranium for this process is made so that 1 cm.^{3} = 1 per cent. $Ca_3P_2O_8$ when working on 1 gram of sample. Where Fe and Al exist in the sample, the P_2O_5 is first precipitated by the citro-magnesic method, dissolved in HNO_3, sodium acetate added, and the titration made with uranium.

2. (Pemberton.) By precipitation as ammonium phosphomolybdate, and titration of the washed precipitate with standard acid and alkali.

Ammonium Molybdate Solution.—Dissolve 90 grams in c. 700 cm.^{3} water, allow to stand some hours, decant from precipitate (if any), dilute to 1 litre. If a precipitate forms, dissolve in a little ammonia and add before diluting.

Standard Potassium Hydroxide.—Dilute 323·7 cm.^{3} N KHO free from CO_2 to 1 litre.

Standard Sulphuric Acid corresponds, 1 cm.^{3} = 1 cm.^{3}, to the potassium hydroxide. 1 gram of the phosphate (of Am, Na, K, Ca, &c., not Fe or Al) is brought into solution in nitric acid, made up to 250 cm.^{3}; and 25 cm.^{3} measured into a small beaker, AmHO added until precipitate begins to form, 5 cm.^{3} of HNO_3 (sp. gr. 1·4) and 10 cm.^{3} of saturated NH_4NO_3 solution added, the mixture diluted to c. 65 cm.^{3}, boiled, the lamp removed, 5 cm.^{3} ammonium molybdate run in slowly with stirring; after about a minute a second 5 cm.^{3} ammonium molybdate is added if required, followed by a third or even fourth 5 cm.^{3} if required. After a few minutes the precipitate is filtered off through a small paper and washed, then dissolved in a measured excess of the standard alkali and titrated back with the standard acid and phenolphthalein. 1 cm.^{3} of alkali neutralised by the precipitate = 1 per cent. P_2O_5.

Silver.—1. By titration with $\frac{N}{10}$ NaCl and K_2CrO_4 indicator in neutral or slightly alkaline solution (*vide* page 417).

2. (Volhard.) By titration with $\frac{N}{10}$ KCNS and a ferric salt indicator (*vide* page 417).

3. (Pisani and Field.) By titration with starch iodide.

Standard Starch Iodide.—Rub 2 grams I with 15 grams starch and 6 or 8 drops of water, digest in a stoppered flask 1 hour, dissolve in water, titrate against a silver solution, 1 gram Ag per litre, in presence of slight excess of pure precipitated $CaCO_3$, dilute until 50 cm.^{3} starch iodide solution = 10 cm.^{3} Ag. solution = ·01 gram Ag. End of the titration is known by the appearance of a blue tint. If Ca present, liquid under assay must be diluted enough to weaken the blue coloration.

4. (Gay-Lussac.) By titration with NaCl.

Standard NaCl.—5·4145 grams pure NaCl per litre.

Decimal NaCl Solution.—Dilute 100 cm.^{3} of standard NaCl solution to 1 litre.

Composition of alloy being approximately known, dissolve a quantity containing a little more than 1 gram in nitric acid, add standard salt solution to precipitate nearly all the Ag, and finish with the decimal salt solution. The end of the reaction is the neutral point when both decimal salt and decimal silver solution (1 gram per litre) give a trace of precipitate.

Sugar.—*Vide* Section XII., p. 510.

Sulphides.—Alkaline sulphide may be titrated with a zinc solution.

Standard Zinc Chloride.—Dissolve 3·253 grams pure Zn in HCl, supersaturate with AmHO and dilute to 1 litre. 1 cm.^{3} = ·0016 gram S = ·0039 gram Na_2S = ·00551 K_2S = ·0034 gram $(NH_4)_2S$.

The (external) indicator is nickel sulphate, the end being reached when this gives no brown coloration.

Sulphurous Acid.—(Giles and Shearer). Add sample (if liquid SO_2 weighed in a bulb) to known excess of $\frac{N}{10}$ I undiluted, and after the reaction titrate back with $\frac{N}{10}$ $Na_2S_2O_3$ and starch. 1 cm.^{3} $\frac{N}{10}$ I = ·0032 gram SO_2.

Sulphuric Acid and Sulphates.—(1) The free acid by titration with standard alkali and methyl-orange as indicator. (2) Sulphates in neutral solution by precipitation with excess of $BaCl_2$, and estimation of the excess with standard potassium chromate, the end being known by supernatant liquid becoming yellow. (3) By titrating with N $BaCl_2$ in acid solution until no more precipitation occurs in a small portion filtered off.

$$1 \text{ cm.}^3 \text{ N } BaCl_2 = \cdot 040 \text{ gram } SO_3.$$

Sulphuretted Hydrogen.—1. (Mohr.) Add the sample to excess of As_2O_3 solution, filter off As_2S_3, determine the excess of As_2O_3, the apparent loss of As_2O_3 is a measure of the H_2S.

$$1 \text{ cm.}^3 \frac{N}{10} As_2O_3 = \cdot 00255 \text{ gram } H_2S.$$

2. (Mohr.) Pass the H_2S into a ferric salt and titrate with $\frac{N}{10}$ $KMnO_4$; 56 $Fe'' = 17$ H_2S. 1 cm.^{3} $\frac{N}{10}$ $KMnO_4$

$$= \cdot 0017 \text{ gram } H_2S.$$

3. By titrating $\frac{N}{100}$ I solution with a sulphuretted water until colour of I disappears, adding starch and $\frac{N}{100}$ I until colour reappears.

Tannic Acid (Lowenthal). 10 to 20 grams of the substance is boiled with water for half an hour, cooled, and diluted to 1 litre. 10 grams tea are boiled with repeated quantities of water. Indigo carmine solution, 20 cm.^{3}, dilute H_2SO_4 (1·10) 10 cm.^{3} are mixed with c. 750 cm.^{3} water in a white dish, and then 5 cm.^{3} of the tannin solution added, and $\frac{N}{30}$ $KMnO_4$ run in very slowly with stirring until a faint pink tint appears at edges of liquid. The indigo carmine having been previously titrated with the $\frac{N}{30}$ $KMnO_4$, the difference gives $KMnO_4$ required for the total oxidisable matter in the original solution. The oxidisable matter other than tannin is next estimated in 50 cm.^{3} of the original liquid after removal of tannin. Mix 50 cm.^{3} tannin solution (Hunt) with 25 cm.^{3} gelatin solution in dry flask and shake, add 50 cm.^{3} saturated NaCl solution (containing 50 cm.^{3} concentrated H_2SO_4 per litre), stir in a little kaolin (Kieselguhr ?), shake, filter, dilute to 100 cm.^{3}, and titrate with $\frac{N}{30}$ $KMnO_4$. Supposing 10 grams of substance under assay to have been used and let $c =$ volume in cm.^{3} of $KMnO_4$ required for 10 cm.^{3} $\frac{N}{10}$ oxalic acid, a the cm.^{3} of $KMnO_4$ required in first titration, and b the cm.^{3} of $KMnO_4$ in the second, then % of tannin (in terms of oxalic acid)

$$= \frac{6 \cdot 3\ (a-b)}{c}$$

0·63 gram of oxalic acid
  = ·04157 gram of gallo-tannic acid (gall nut tannin).
  = ·062355 gram querci-tannic acid (oak bark tannin).

Solutions required are

$\frac{N}{30}$ $KMnO_4$ set against $\frac{N}{10}$ oxalic acid.

Indigo carmine solution. 5 grams, 50 cm.^{3} pure H_2SO_4, dilute to 1 litre.

Gelatin solution. Dissolve 2 grams to 100 cm.^{3} and filter.

Tin.—1. $SnCl_2$ is mixed with Rochelle salt and excess of $NaHCO_3$, starch added, and then $\frac{N}{10}$ I 1 cm.^{3} = ·0059 gram Sn.

2. $SnCl_2$ is introduced into ferric salt and the Fe″ formed estimated. $SnCl_2 + 2Fe_2Cl_6 = SnCl_4 + 2\ FeCl_2$.

Fe × 1·0536 = Sn.

$FeAm_2(SO_4)_2$, 6 aq. × ·1505 = Sn.

1 cm.^{3} $\frac{N}{10}$ I = ·0059 gram Sn.

1 cm.^{3} $\frac{N}{10}$ $KMnO_4$ = ·0059 gram Sn.

Uranium.—Reduce with Zn and H_2SO_4, and titrate with standard $KMnO_4$ in absence of nitrates. 56 Fe = 120 U.

Zinc.—1. (Mann.) Dissolve in HNO_3, precipitate Cu, &c. with H_2S, precipitate Fe, Al, &c. with AmHO, throw down zinc as hydrated sulphide, add excess of AgCl, boil, add a few drops dilute H_2SO_4, filter, and estimate Cl in the cool mixed filtrate and washing by adding first excess of standard $AgNO_3$ and titrating back with standard ammonium thiocyanate.

Standard Silver Nitrate.—33·18 grams Ag, or 52·3 grams $AgNO_3$ per litre. 1 cm.^{3} = ·01 gram Zn.

Standard AmCNS, 3 cm.^{3} = 1 cm.^{3} of the Ag. solution.

2. (Schwarz.) Or, precipitate as ZnS, wash, dissolve in ferric sulphate and sulphuric acid, and estimate the Fe″ produced. 2 Fe = Zn.

3. Precipitate with standard sodium sulphide, set against a standard zinc solution, 44·12 grams $ZnSO_4$, 7aq per litre. 1 cm.^{3} = ·01 gram Zn. The (external) indicator is made by dissolving lead acetate in tartaric acid and excess of caustic soda. Or (Schaffner), titrate at c. 50° C. with sodium sulphide (1 cm.^{3} = ·01 gram Zn) and a few drops of iron previously added as (internal) indicator.

4. (Galetti.) By titration with standard potassium ferrocyanide (11·25 grams per litre; 1 cm.^{3} = ·01 gram Zn) in acetic acid solution, with uranium (external) indicator.

5. (Leison). Zn (or Cd) is precipitated as oxalate, the precipitate washed, dissolved in dilute H_2SO_4, and titrated with $\frac{N}{10}$ $KMnO_4$, 1 cm.^{3} = ·00325 gram Zn.

The metallic Zn in zinc dust may be estimated by dissolving in dilute acid in the nitrometer.

TABLE I.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS WITH DIFFERENT CORRECTIONS (WORRALL).

These tables are for use in volumetric analysis when standard solutions are used which are not exactly normal or decinormal. The "factor" is given at the head of the columns, and the numbers representing the cubic centimeters at the left-hand side. Thus suppose the solution to be weak, and its factor to be ·915, if 20 cubic centimeters have been used, the real value is 18·3.

	·900	·905	·910	·915	·920	·925	·930	·935	·940	·945
2	1·8	1·81	1·82	1·83	1·84	1·85	1·86	1·87	1·88	1·89
3	2·7	2·715	2·73	2·745	2·76	2·775	2·79	2·805	2·82	2·835
4	3·6	3·62	3·64	3·66	3·68	3·7	3·72	3·74	3·76	3·78
5	4·5	4·525	4·55	4·575	4·6	4·625	4·65	4·675	4·7	4·725
6	5·4	5·43	5·46	5·49	5·52	5·55	5·58	5·61	5·64	5·67
7	6·3	6·335	6·37	6·405	6·44	6·475	6·51	6·545	6·58	6·615
8	7·2	7·24	7·28	7·32	7·36	7·4	7·44	7·48	7·52	7·56
9	8·1	8·145	8·19	8·235	8·28	8·325	8·37	8·415	8·46	8·505
10	9·	9·05	9·1	9·15	9·2	9·25	9·3	9·35	9·4	9·45
11	9·9	9·955	10·01	10·065	10·12	10·175	10·23	10·285	10·34	10·395
12	10·8	10·86	10·92	10·98	11·04	11·1	11·16	11·22	11·28	11·34
13	11·7	11·765	11·83	11·895	11·96	12·025	12·09	12·155	12·22	12·285
14	12·6	12·67	12·74	12·81	12·88	12·95	13·02	13·09	13·16	13·23
15	13·5	13·575	13·65	13·725	13·8	13·875	13·95	14·025	14·1	14·175
16	14·4	14·48	14·56	14·64	14·72	14·8	14·88	14·96	15·04	15·12
17	15·3	15·385	15·47	15·555	15·64	15·725	15·81	15·895	15·98	16·065
18	16·2	16·29	16·38	16·47	16·56	16·65	16·74	16·83	16·92	17·01
19	17·1	17·195	17·29	17·385	17·48	17·575	17·67	17·765	17·86	17·955
20	18·	18·1	18·2	18·3	18·4	18·5	18·6	18·7	18·8	18·9
21	18·9	19·005	19·11	19·215	19·32	19·425	19·53	19·635	19·74	19·845
22	19·8	19·91	20·02	20·13	20·24	20·35	20·46	20·57	20·68	20·79
23	20·7	20·815	20·93	21·045	21·16	21·275	21·39	21·505	21·62	21·735

TABLE I.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	·950	·955	·960	·965	·970	·975	·980	·985	·990	·995
2	1·9	1·91	1·92	1·93	1·94	1·95	1·96	1·97	1·98	1·99
3	2·85	2·865	2·88	2·895	2·91	2·925	2·94	2·955	2·97	2·985
4	3·8	3·82	3·84	3·86	3·88	3·9	3·92	3·94	3·96	3·98
5	4·75	4·775	4·8	4·825	4·85	4·875	4·9	4·925	4·95	4·975
6	5·7	5·73	5·76	5·79	5·82	5·85	5·88	5·91	5·94	5·97
7	6·65	6·685	6·72	6·755	6·79	6·825	6·86	6·895	6·93	6·965
8	7·6	7·64	7·68	7·72	7·76	7·8	7·84	7·88	7·92	7·96
9	8·55	8·595	8·64	8·685	8·73	8·775	8·82	8·865	8·91	8·955
10	9·5	9·55	9·6	9·65	9·7	9·75	9·8	9·85	9·9	9·95
11	10·45	10·505	10·56	10·615	10·67	10·725	10·78	10·835	10·89	10·945
12	11·4	11·46	11·52	11·58	11·64	11·7	11·76	11·82	11·88	11·94
13	12·35	12·415	12·48	12·545	12·61	12·675	12·74	12·805	12·87	12·935
14	13·3	13·37	13·44	13·51	13·58	13·65	13·72	13·79	13·86	13·93
15	14·25	14·325	14·4	14·475	14·55	14·625	14·7	14·775	14·85	14·925
16	15·2	15·28	15·36	15·44	15·52	15·6	15·68	15·76	15·84	15·92
17	16·15	16·235	16·32	16·405	16·49	16·575	16·66	16·745	16·83	16·915
18	17·1	17·19	17·28	17·37	17·46	17·55	17·64	17·73	17·82	17·91
19	18·05	18·145	18·24	18·335	18·43	18·525	18·62	18·715	18·81	18·905
20	19·	19·1	19·2	19·3	19·4	19·5	19·6	19·7	19·8	19·9
21	19·95	20·055	20·16	20·265	20·37	20·475	20·58	20·685	20·79	20·895
22	20·9	21·01	21·12	21·23	21·34	21·45	21·56	21·67	21·78	21·89
23	21·85	21·965	22·08	22·195	22·31	22·425	22·54	22·655	22·77	22·885

TABLE I.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	·900	·905	·910	·915	·920	·925	·930	·935	·940	·945
24	21·6	21·72	21·84	21·96	22·08	22·2	22·32	22·44	22·56	22·68
25	22·5	22·625	22·75	22·875	23·	23·125	23·25	23·375	23·5	23·625
26	23·4	23·53	23·66	23·79	23·92	24·05	24·18	24·31	24·44	24·57
27	24·3	24·435	24·57	24·705	24·84	24·975	25·11	25·245	25·38	25·515
28	25·2	25·34	25·48	25·62	25·76	25·9	26·04	26·18	26·32	26·46
29	26·1	26·245	26·39	26·535	26·68	26·825	26·97	27·115	27·26	27·405
30	27·	27·15	27·3	27·45	27·6	27·75	27·9	28·05	28·2	28·35
31	27·9	28·055	28·21	28·365	28·52	28·675	28·83	28·985	29·14	29·295
32	28·8	28·96	29·12	29·28	29·44	29·6	29·76	29·92	30·08	30·24
33	29·7	29·865	30·03	30·195	30·36	30·525	30·69	30·855	31·02	31·185
34	30·6	30·77	30·94	31·11	31·28	31·45	31·62	31·79	31·96	32·13
35	31·5	31·675	31·85	32·025	32·2	32·375	32·55	32·725	32·9	33·075
36	32·4	32·58	32·76	32·94	33·12	33·3	33·48	33·66	33·84	34·02
37	33·3	33·485	33·67	33·855	34·04	34·225	34·41	34·595	34·78	34·965
38	34·2	34·39	34·58	34·77	34·96	35·15	35·34	35·53	35·72	35·91
39	35·1	35·295	35·49	35·685	35·88	36·075	36·27	36·465	36·66	36·855
40	36·	36·2	36·4	36·6	36·8	37·	37·2	37·4	37·6	37·8
41	36·9	37·105	37·31	37·515	37·72	37·925	38·13	38·335	38·54	38·745
42	37·8	38·01	38·22	38·43	38·64	38·85	39·06	39·27	39·48	39·69
43	38·7	38·915	39·13	39·345	39·56	39·775	39·99	40·205	40·42	40·635
44	39·6	39·82	40·04	40·26	40·48	40·7	40·92	41·14	41·36	41·58
45	40·5	40·725	40·95	41·175	41·4	41·625	41·85	42·075	42·3	42·525
46	41·4	41·63	41·86	42·09	42·32	42·55	42·78	43·01	43·24	43·47
47	42·3	42·535	42·77	43·005	43·24	43·475	43·71	43·945	44·18	44·415
48	43·2	43·44	43·68	43·92	44·16	44·4	44·64	44·88	45·12	45·36
49	44·1	44·345	44·59	44·835	45·08	45·325	45·57	45·815	46·06	46·305
50	45·	45·25	45·5	45·75	46·	46·25	46·5	46·75	47·	47·25

TABLE I.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	·950	·955	·960	·965	·970	·975	·980	·985	·990	·995
24	22·8	22·92	23·04	23·16	23·28	23·4	23·52	23·64	23·76	23·88
25	23·75	23·875	24·	24·125	24·25	24·375	24·5	24·625	24·75	24·875
26	24·7	24·83	24·96	25·09	25·22	25·35	25·48	25·61	25·74	25·87
27	25·65	25·795	25·92	26·055	26·19	26·325	26·46	26·595	26·73	26·865
28	26·6	26·75	26·88	27·02	27·16	27·3	27·44	27·58	27·72	27·86
29	27·55	27·705	27·84	27·985	28·13	28·275	28·42	28·565	28·71	28·855
30	28·5	28·66	28·8	28·95	29·1	29·25	29·4	29·55	29·7	29·85
31	29·45	29·615	29·76	29·915	30·07	30·225	30·38	30·535	30·69	30·845
32	30·4	30·57	30·72	30·88	31·04	31·2	31·36	31·52	31·68	31·84
33	31·35	31·515	31·68	31·845	32·01	32·175	32·34	32·505	32·67	32·835
34	32·3	32·47	32·64	32·81	32·98	33·15	33·32	33·49	33·66	33·83
35	33·25	33·425	33·6	33·775	33·95	34·125	34·3	34·475	34·65	34·825
36	34·2	34·38	34·56	34·74	34·92	35·1	35·28	35·46	35·64	35·82
37	35·15	35·335	35·52	35·705	35·89	36·075	36·26	36·446	36·63	36·815
38	36·1	36·29	36·48	36·67	36·86	37·05	37·24	37·43	37·62	37·81
39	37·05	37·245	37·44	37·635	37·83	38·025	38·22	38·415	38·61	38·805
40	38·	38·2	38·4	38·6	38·8	39·	39·2	39·4	39·6	39·8
41	38·95	39·155	39·36	39·565	39·77	39·975	40·18	40·385	40·59	40·795
42	39·9	40·11	40·32	40·53	40·74	40·95	41·16	41·37	41·58	41·79
43	40·85	41·065	41·28	41·495	41·71	41·925	42·14	42·355	42·57	42·785
44	41·8	42·02	42·24	42·46	42·68	42·9	43·12	43·34	43·56	43·78
45	42·75	42·975	43·2	43·425	43·65	43·875	44·1	44·325	44·55	44·775
46	43·7	43·93	44·16	44·39	44·62	44·85	45·08	45·31	45·54	45·77
47	44·65	44·885	45·12	45·355	45·59	45·825	46·06	46·295	46·53	46·765
48	45·6	45·84	46·08	46·32	46·56	46·8	47·04	47·28	47·52	47·76
49	46·55	46·795	47·04	47·285	47·53	47·775	48·02	48·265	48·51	48·755
50	47·5	47·75	48·	48·25	48·5	48·75	49·	49·25	49·5	49·75

TABLE II.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.

	1·005	1·010	1·015	1·02	1·025	1·03	1·035	1·04	1·045	1·05
2	2·01	2·02	2·03	2·04	2·05	2·06	2·07	2·08	2·09	2·10
3	3·015	3·03	3·045	3·06	3·075	3·09	3·105	3·12	3·135	3·15
4	4·02	4·04	4·06	4·08	4·1	4·12	4·14	4·16	4·18	4·2
5	5·025	5·05	5·075	5·1	5·125	5·15	5·175	5·2	5·225	5·25
6	6·03	6·06	6·08	6·12	6·15	6·18	6·21	6·24	6·27	6·3
7	7·035	7·07	7·105	7·14	7·175	7·21	7·245	7·28	7·315	7·35
8	8·04	8·08	8·12	8·16	8·2	8·24	8·28	8·32	8·36	8·4
9	9·045	9·09	9·135	9·18	9·225	9·27	9·315	9·36	9·405	9·45
10	10·05	10·10	10·15	10·2	10·25	10·3	10·35	10·4	10·45	10·5
11	11·055	11·11	11·165	11·22	11·275	11·33	11·385	11·44	11·495	11·55
12	12·06	12·12	12·18	12·24	12·3	12·36	12·42	12·48	12·54	12·6
13	13·065	13·13	13·195	13·26	13·325	13·39	13·455	13·52	13·585	13·65
14	14·07	14·14	14·21	14·28	14·35	14·42	14·49	14·56	14·63	14·7
15	15·075	15·15	15·225	15·3	15·375	15·45	15·525	15·6	15·675	15·75
16	16·08	16·16	16·24	16·32	16·4	16·48	16·56	16·64	16·72	16·8
17	17·085	17·17	17·255	17·34	17·425	17·51	17·595	17·68	17·765	17·85
18	18·09	18·18	18·27	18·36	18·45	18·54	18·63	18·72	18·81	18·9
19	19·095	19·19	19·285	19·38	19·475	19·57	19·665	19·76	19·855	19·95
20	20·1	20·2	20·3	20·4	20·5	20·6	20·7	20·8	20·9	21·
21	21·105	21·21	21·315	21·42	21·525	21·63	21·735	21·84	21·945	22·05
22	22·11	22·22	22·33	22·44	22·55	22·66	22·77	22·88	22·99	23·1
23	23·115	23·23	23·345	23·46	23·575	23·69	23·805	23·92	24·035	24·15
24	24·12	24·24	24·36	24·48	24·6	24·72	24·84	24·96	25·08	25·2
25	25·125	25·25	25·375	25·5	25·625	25·75	25·875	26·	26·125	26·25

TABLE II.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	1·055	1·06	1·065	1·07	1·075	1·08	1·085	1·09	1·095	1·1
2	2·11	2·12	2·13	2·14	2·15	2·16	2·17	2·18	2·19	2·2
3	3·165	3·18	3·195	3·21	3·225	3·24	3·255	3·27	3·285	3·3
4	4·22	4·24	4·26	4·28	4·3	4·32	4·34	4·36	4·38	4·4
5	5·275	5·3	5·325	5·35	5·375	5·4	5·425	5·45	5·475	5·5
6	6·33	6·36	6·39	6·42	6·45	6·48	6·51	6·54	6·57	6·6
7	7·385	7·42	7·455	7·49	7·525	7·56	7·595	7·63	7·665	7·7
8	8·44	8·48	8·52	8·56	8·6	8·64	8·68	8·72	8·76	8·8
9	9·495	9·54	9·585	9·63	9·675	9·72	9·765	9·81	9·855	9·9
10	10·55	10·6	10·65	10·7	10·75	10·8	10·85	10·9	10·95	11·
11	11·605	11·66	11·715	11·77	11·825	11·88	11·935	11·99	12·045	12·1
12	12·66	12·72	12·78	12·84	12·9	12·96	13·02	13·08	13·14	13·2
13	13·715	13·78	13·845	13·91	13·975	14·04	14·105	14·17	14·235	14·3
14	14·77	14·84	14·91	14·98	15·05	15·12	15·19	15·26	15·33	15·4
15	15·825	15·9	15·975	16·05	16·125	16·2	16·275	16·35	16·425	16·5
16	16·88	16·96	17·04	17·12	17·2	17·28	17·36	17·44	17·52	17·6
17	17·935	18·02	18·105	18·19	18·275	18·36	18·445	18·53	18·615	18·7
18	18·99	19·08	19·17	19·26	19·35	19·44	19·53	19·62	19·71	19·8
19	20·045	20·14	20·235	20·33	20·425	20·52	20·615	20·71	20·805	20·9
20	21·1	21·2	21·3	21·4	21·5	21·6	21·7	21·8	21·9	22·
21	22·155	22·26	22·365	22·47	22·575	22·68	22·785	22·89	22·995	23·1
22	23·21	23·32	23·43	23·54	23·65	23·76	23·87	23·98	24·09	24·2
23	24·265	24·38	24·495	24·61	24·725	24·84	24·955	25·07	25·185	25·3
24	25·32	25·44	25·56	25·68	25·8	25·92	26·04	26·16	26·28	26·4
25	26·375	26·5	26·625	26·75	26·875	27·	27·125	27·25	27·375	27·5

TABLE II.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	1·005	1·010	1·015	1·02	1·025	1·03	1·035	1·04	1·045	1·05
26	26·13	26·26	26·39	26·52	26·65	26·78	26·91	27·04	27·17	27·3
27	27·135	27·27	27·405	27·54	27·675	27·81	27·945	28·08	28·215	28·35
28	28·14	28·28	28·42	28·56	28·7	28·84	28·98	29·12	29·26	29·4
29	29·145	29·29	29·435	29·58	29·725	29·87	30·015	30·16	30·305	30·45
30	30·15	30·3	30·45	30·6	30·75	30·9	31·05	31·2	31·35	31·5
31	31·155	31·31	31·465	31·62	31·775	31·93	32·085	32·24	32·395	32·55
32	32·16	32·32	32·48	32·64	32·8	32·96	33·12	33·28	33·44	33·6
33	33·165	33·33	33·495	33·66	33·825	33·99	34·155	34·32	34·485	34·65
34	34·17	34·34	34·51	34·68	34·85	35·02	35·19	35·36	35·53	35·7
35	35·175	35·35	35·525	35·7	35·875	36·05	36·225	36·4	36·575	36·75
36	36·18	36·36	36·54	36·72	36·9	37·08	37·26	37·44	37·62	37·8
37	37·185	37·37	37·555	37·74	37·925	38·11	38·295	38·48	38·665	38·85
38	38·19	38·38	38·57	38·76	38·95	39·14	39·33	39·52	39·71	39·9
39	39·195	39·39	39·585	39·78	39·975	40·17	40·365	40·56	40·755	40·95
40	40·2	40·4	40·6	40·8	41·	41·2	41·4	41·6	41·8	42·
41	41·205	41·41	41·615	41·82	42·025	42·23	42·435	42·64	42·845	43·05
42	42·21	42·42	42·63	42·84	43·05	43·26	43·47	43·68	43·89	44·1
43	43·215	43·43	43·645	43·86	44·075	44·29	44·505	44·72	44·935	45·15
44	44·22	44·44	44·66	44·88	45·1	45·32	45·54	45·76	45·98	46·2
45	45·225	45·45	45·675	45·9	46·125	46·35	46·575	46·8	47·025	47·25
46	46·23	46·46	46·69	46·92	47·15	47·38	47·61	47·84	48·07	48·3
47	47·235	47·47	47·705	47·94	48·175	48·41	48·645	48·88	49·115	49·35
48	48·24	48·48	48·72	48·96	49·2	49·44	49·68	49·92	50·16	50·4
49	49·245	49·49	49·735	49·98	50·225	50·47	50·715	50·96	51·205	51·45
50	50·25	50·5	50·75	51·	51·25	51·5	51·75	52·	52·25	52·5

TABLE II.—FOR CALCULATING THE VALUE OF CUBIC CENTIMETERS, &C.—*continued.*

	1·055	1·06	1·065	1·07	1·075	1·08	1·085	1·09	1·095	1·1
26	27·43	27·56	27·69	27·82	27·95	28·08	28·21	28·34	28·47	28·6
27	28·485	28·62	28·755	28·89	29·025	29·16	29·295	29·43	29·565	29·7
28	29·54	29·68	29·82	29·96	30·1	30·24	30·38	30·52	30·66	30·8
29	30·595	30·74	30·885	31·03	31·175	31·32	31·465	31·61	31·755	31·9
30	31·65	31·8	31·95	32·1	32·25	32·4	32·55	32·7	32·85	33·
31	32·705	32·86	33·015	33·17	33·325	33·48	33·635	33·79	33·945	34·1
32	33·76	33·92	34·08	34·24	34·4	34·56	34·72	34·88	35·04	35·2
33	34·815	34·98	35·145	35·31	35·475	35·64	35·805	35·97	36·135	36·3
34	35·87	36·04	36·21	36·38	36·55	36·72	36·89	37·06	37·23	37·4
35	36·925	37·1	37·275	37·45	37·625	37·8	37·975	38·15	38·325	38·5
36	37·98	38·16	38·34	38·52	38·7	38·88	39·06	39·24	39·42	39·6
37	39·035	39·22	39·405	39·59	39·775	39·96	40·145	40·33	40·515	40·7
38	40·09	40·28	40·47	40·66	40·85	41·04	41·23	41·42	41·61	41·8
39	41·145	41·34	41·535	41·73	41·925	42·12	42·315	42·51	42·705	42·9
40	42·2	42·4	42·6	42·8	43·	43·2	43·4	43·6	43·8	44·
41	43·255	43·46	43·665	43·87	44·075	44·28	44·485	44·69	44·895	45·1
42	44·31	44·52	44·73	44·94	45·15	45·36	45·57	45·78	45·99	46·2
43	45·365	45·58	45·795	46·01	46·225	46·44	46·655	46·87	47·085	47·3
44	46·42	46·64	46·86	47·08	47·3	47·52	47·74	47·96	48·18	48·4
45	47·475	47·7	47·925	48·15	48·375	48·6	48·825	49·05	49·275	49·5
46	48·53	48·76	48·99	49·22	49·45	49·68	49·91	50·14	50·37	50·8
47	49·585	49·82	50·055	50·29	50·525	50·76	50·995	51·23	51·465	51·7
48	50·64	50·88	51·12	51·36	51·6	51·84	52·08	52·32	52·56	52·8
49	51·695	51·94	52·185	52·43	52·675	52·92	53·165	53·41	53·655	53·9
50	52·75	53·	53·25	53·5	53·75	54·	54·25	54·5	54·75	55·

(C) *WATER ANALYSIS.*

REAGENTS REQUIRED.

Standard $AgNO_3$.—Dissolve 4·7887 grams in water to 1 litre; 1 cm.^{3} = ·001 gram Cl.

Standard NaCl.—Dissolve 1·648 gram to 1 litre; 1 cm.^{3} = ·001 gram Cl.

Potassium Chromate Solution. Dissolve 50 grams of monochromate to 1 litre, add silver nitrate drop by drop until a permanent precipitate is produced, and allow to settle.

Ammonium Molybdate Solution. Dissolve 1 part of pure molybdic acid in 4 parts of ammonia solution of sp. gr. ·960; filter, and pour with stirring into 15 parts of pure nitric acid of sp. gr. 1·20; keep in a dark place.

Sulphuric Acid free from nitrates. The concentrated acid is kept in a bottle containing mercury, and shaken at intervals.

Aluminium in thin foil.

Sodium Hydroxide. Dissolve 100 grams to 1 litre; when cold, dissolve c. 15 sq. in. aluminium foil in the solution (to remove nitrates), boil down to c. 700 cm.^{3}, cool, dilute to 1 litre with ammonia-free water.

Potassium Hydroxide. Dissolve to a cold saturated solution.

Pumice. Remove dust from coarsely powdered pumice, and heat to redness.

Hydrochloric Acid, freed from ammonia by distillation.

Copper Sulphate. Dissolve 30 grams to 1 litre.

Zinc. Thin foil kept in a stoppered bottle.

Standard Ammonium Chloride.—Dissolve 3·15 grams to 1 litre, using ammonia-free water. Make with same water a standard solution of $\frac{1}{100}$th strength; 1 cm.^{3} = ·00001 gram NH_3.

Nessler's Solution. Dissolve 62·5 grams KI in c. 250 cm.^{3} water, add concentrated $HgCl_2$ solution with stirring until a permanent precipitate appears, taking care to stop at this point. Dissolve 150 grams stick potassium hydrate in 150 cm.^{3} water, cool, add to the KI solution, and dilute to 1 litre. Decant from the precipitate which forms. Nessler's reagent is sometimes made of about half this concentration.

Sodium Carbonate Solution (for Nesslerising). Dissolve recently ignited Na_2CO_3 to a 20 per cent. solution.

Alkaline Permanganate Solution (for Nesslerising). Dissolve 200 grams potassium hydroxide and 8 grams pure $KMnO_4$ in 1100 cm.^{3} water, and boil down to 1 litre.

Water, free from ammonia. Distil ordinary distilled water until the distillate gives no ammonia with Nessler's solution, and collect.

Standard Permanganate (for O absorbed).—Dissolve ·395 gram pure $KMnO_4$ to 1 litre; 1 cm.^{3} = ·0001 gram O.

Potassium Iodide Solution. Dissolve 1 gram in 10 cm.^{3} water.

Dilute Sulphuric Acid (for O absorbed). Mix 1 vol. pure concentrated acid with 3 vol. water, and add solution of $KMnO_4$ until very faintly pink tint remains after keeping at 80° C. for four hours.

Sodium Thiosulphate Solution (for O absorbed). Dissolve 1 gram to 1 litre.

Standard $CaCl_2$.—Dissolve 1·144 gram pure calcite in dilute HCl in a covered beaker, evaporate to dryness, redissolve in about 10 cm.^{3} water, and re-evaporate; repeat evaporation several times, and dissolve to 1 litre.

Standard Hard Water.—Dilute 1 vol. of standard $CaCl_2$ to 10 vols. This gives water of 8 degrees of hardness.

Standard Potash Soap Solution.—Rub 150 grams Emplast. Plumbi B.P. (soap plaster) with 40 grams dry K_2CO_3, add a little strong spirit (meth.), and rub to a cream. Filter after a few hours, and wash filter with alcohol (meth.). Dilute with dilute alcohol (meth.) (1 vol. water and 2 vols. alcohol) until 14·25 cm.^{3} form a permanent lather with 50 cm.^{3} of standard $CaCl_2$.

The following additional reagents are required for use with gas apparatus.

For determination of organic C and N:—

Sulphurous Acid.—Soak strips of copper in concentrated sulphuric acid for 24 hours, and wash strips with water. Evolve SO_2 by heating the copper with pure H_2SO_4, and pass into pure ammonia-free water until saturated.

Sodium Hydrogen Sulphite Solution. Pass SO_2 obtained as above into a solution of ignited Na_2CO_3 until evolution of CO_2 ceases.

Ferrous Chloride Solution. Add caustic soda solution to solution of pure $FeSO_4$, 7 aq, wash precipitate with ammonia-free water, and dissolve in the minimum of pure hydrochloric acid. The resulting solution must be free from NH_3.

Copper Oxide. Prepared by roasting copper. When tested by blank combustion, no gas should be evolved.

Copper Gauze. Cartridges of gauze are heated to redness in a combustion tube, roasted in a current of air for a few minutes, and dry hydrogen passed for some time at a red heat, and while the copper cools.

Pyrogallic Acid Solution. Dissolve pure sublimed acid to a cold saturated solution.

Cuprous Chloride Solution. A cold saturated solution of $CuCl_2$ is digested until colourless with metallic copper, after freely acidulating with HCl.

Metaphosphoric Acid. Dissolve 100 grams acid free from ammonia to 1 litre, using ammonia-free water.

Calcium Phosphate. Prepared from $CaCl_2$ by precipitation with disodic phosphate, washing, drying, and igniting to redness for one hour.

For determination of N by Crum's process:—

Sulphuric Acid. The concentrated acid free from nitrites and nitrates.

Potassium Permanganate Solution. Dissolve 10 grams to 1 litre.

Sodium Carbonate Solution. Dissolve 10 grams dry Na_2CO_3, free from nitrates, to 1 litre.

For determination of Nitrites by Griess's process:—

Meta-phenylene-diamine Solution. Dissolve ·5 gram in 100 cm.³ of very dilute HCl or H_2SO_4.

Dilute Sulphuric Acid. Mix 1 vol. pure acid with 2 vols. water.

Standard Na or K Nitrite Solution.—Dissolve ·406 gram pure $AgNO_2$ in boiling water, and add solution of KCl or NaCl until Ag is precipitated, dilute to 1 litre, let AgCl subside, and dilute 100 cm.³ of clear liquid to 1 litre; 1 cm.³ = ·00001 gram N_2O_3.

Phenol-Sulphonic Acid (for Nitrates, Sprengel). Heat 80 cm.³ of phenol with 200 cm.³ of pure concentrated H_2SO_4 for 8 hours, cool, and to each vol. of the phenol-sulphonic acid add 420 cm.³ of water, and 120 cm.³ of strong hydrochloric acid.

Standard KNO_3 (Sprengel). Dissolve 7·22 grams KNO_3 to 1 litre, and then dilute 100 cm.³ to 1 litre to make required solution, of which 1 cm.³ = ·0001 gram N = 1 in 100,000 when 10 cm.³ are used for Sprengel's method.

CALCULATION

of Results in Water Analysis, with Notes.

Nitrogen as Ammonia (Crum). Evaporate 250 cm.³ to dryness, extract with c. 30 cm.³ water, evaporate to c. 1 cm.³, introduce into the nitrometer, rinse cup once with a little hot water, add about $1\frac{1}{2}$ vols. concentrated sulphuric acid (free from N) the total volume being now c. 6 cm.^{3}; shake, and measure NO.

Let $v =$ cm.^{3} of NO, $B =$ height of barometer, $W =$ tension of aqueous vapour at temperature of observation (see p. 366).

$$\text{N in grains per gallon} = v \times \frac{\cdot 0012562}{760\,(1 + \cdot 00367\,t)} \times \left(B - W\right)$$

$\times$ 140 (see tables, Section VII., pp. 291 *et seq.*), or cm.^{3} of NO (corrected) $\times \cdot 175 =$ grains of N per gallon.

N in Nitrates as Ammonia, by copper zinc couple. Operate on 100 cm.^{3} water at c. 30° C. in a stoppered bottle, estimate NH_3 by Nessler's solution (with or without distillation according to circumstances, vide Sutton, p. 435). Grams of $NH_3 \times 576 \cdot 45 =$ grains of N per gallon. Correct for NH_3 and nitrites originally present.

N in Nitrates by Aluminium. Take 50 cm.^{3}, add 50 cm.^{3} of 10 per cent. caustic soda free from nitrates, and distil until NH_3 ceases to appear in distillate, cool, add aluminium, attach tubes containing acid for prevention of escape of NH_3, and tube for prevention of air contamination; return contents of former tube to retort, distil and Nesslerise. Grams of $NH_3 \times 1152 \cdot 9 =$ grains of N per gallon.

Free or Albumenoid Ammonia. Determine by Nesslerising, using 500 cm.^{3}; then cm.^{3} standard $NH_4Cl \times \cdot 0014$ = grains NH_3 per gallon.

Chlorine. Titrate 100 cm.^{3} with standard $AgNO_3$ and chromate indicator; then cm.^{3} of $AgNO_3 \times \cdot 7 =$ grains Cl per gallon.

Oxygen absorbed from permanganate. Use 250 cm.^{3} water, 10 cm.^{3} standard permanganate, and 10 cm^3 dilute H_2SO_4, making two tests, both at 80° C., one after 15 minutes, the other after 4 hours. After standing required time, add a few drops of the KI solution and titrate with standard $Na_2S_2O_3$. Set the standard $Na_2S_2O_3$ with 250 cm.^{3} distilled water, 10 cm.^{3} permanganate, and 10 cm.^{3} sulphuric acid. Let $A =$ cm.^{3} $Na_2S_2O_3$ used in setting with distilled water, and $B =$ cm.^{3} $Na_2S_2O_3$ used for water under examination; $A - B$ = permanganate reduced by organic matter in the water, and

$$\frac{A - B \times \cdot 001}{A} = \text{O for 250 cm.}^3 \text{ of sample,}$$

or

$$\frac{A - B \times \cdot 4}{A} = \text{parts of O per 100,000 parts of water.}$$

Organic C and N by combustion. After evaporation with H_2SO_3, &c., &c., and collection of gas by means of the Sprengel pump, remove SO_2 (if any) with solution of $K_2Cr_2O_7$, and measure vol. of total gas (= A); absorb CO_2 and measure vol. (= B); introduce oxygen to convert NO into NO_2, remove this with potash, and measure C, the vol. of residual nitrogen.

$$\text{Vol. of } CO_2 = A - B,$$
$$\text{Vol. of N} = \frac{B + C}{2},$$

from which the weights of the gases may be calculated. It is easier, however, to assume that the gas in all three stages is N; then if A = weight of total gas, B = weight after absorption with potash, and C = weight of N,

$$\text{weight of C} = \frac{(A - B)\,3}{7}\,;\ \text{weight of N} = \frac{B + C}{2}.$$

If t = temperature of observation, the weight of N is

$$\frac{\cdot 0012562 \times \text{vol. of N in cm.}^3 \times \text{pressure in mm. corrected for tension of aqueous vapour}}{(1 + \cdot 00367\,t)\,760}.$$

See table p. 350, also various tables in Section VII.

VALUE OF $\frac{0\cdot 0012562}{760\,(1 + 0\cdot 00367\,t)}$ FOR TEMPERATURE 0° C–32° C.

$t°$.	a	$t°$.	a	$t°$.	a	$t°$.	a
	0·00000		0·00000		0·00000		0·00000
0	16529	9	16000	18	15505	27	15039
1	16468	10	15944	19	15452	28	14989
2	16409	11	15888	20	15399	29	14939
3	16349	12	15832	21	15346	30	14890
4	16290	13	15776	22	15294	31	14841
5	16231	14	15721	23	15242	32	14792
6	16173	15	15667	24	15191		
7	16115	16	15612	25	15140		
8	16057	17	15558	26	15089		

When the N as NH_3 exceeds ·007 part per 100,000, a loss of which occurs during evaporation with H_2SO_3, this is given in table on p. 446, and should be added to the N found by combustion. The table on p. 448 is used when NH_3 has been determined instead of N as NH_3. In the case of sewage, where metaphosphoric acid is used instead of sulphurous acid, the tables on pp. 447 and 449 are employed respectively.

Total Solids. Use 250 cm.^{3}; then grams of residue × 280 = grams per gallon.

Nitrogen by Phenol-Sulphonic Acid (Sprengel). Evaporate 10 (20, 50, &c.) cm.^{3} of the water, and 10 cm.^{3} of standard KNO_3, to dryness in a water bath in separate vessels, to each add 1 cm.^{3} phenol-sulphonic acid, mix and digest in water bath for 15 minutes, add 20 cm.^{3} of ammonia (sp. gr. ·96), dilute to 100 cm.^{3}, add Nessler's solution, and compare tint of water solution with tint from standard KNO_3 in Nessler glasses. N as nitrites give no coloration, and are not estimated. See p. 443.

RULES FOR CONVERTING PARTS PER 100,000 INTO GRAIN PER GALLON, OR THE REVERSE.

To convert parts per 100,000 into grains per gallon, multiply by 0·7.

To convert grains per gallon into parts per 100,000, divid by 0·7.

To convert grains per litre into grains per gallon, multip l by 70.

1 grain per gallon = ·01425 gram per litre.

For Tension of Aqueous Vapour see pp. 336 *et seq.*

For Reduction of cm.^{3} of Nitrogen to grams see pp. 348–358.

LOSS OF NITROGEN BY EVAPORATION OF NH_3 WITH SULPHUROUS ACID. (Parts per 100,000.)

N as NH_3.	Loss of N.	N as NH_3.	Loss of N.	N as NH_3.	Loss of N.	N as NH_3.	Loss of N.
5·0	1·741	3·4	1·186	1·8	·418	·2	·038
4·9	1·717	3·3	1·138	1·7	·370	·1	·020
4·8	1·693	3·2	1·090	1·6	·338	·09	·018
4·7	1·669	3·1	1·042	1·5	·324	·08	·017
4·6	1·645	3·0	·994	1·4	·309	·07	·015
4·5	1·621	2·9	·946	1·3	·295	·06	·013
4·4	1·598	2·8	·898	1·2	·280	·05	·011
4·3	1·574	2·7	·850	1·1	·266	·04	·009
4·2	1·550	2·6	·802	1·0	·252	·03	·007
4·1	1·521	2·5	·754	·9	·237	·02	·005
4·0	1·473	2·4	·706	·8	·217	·01	·003
3·9	1·425	2·3	·658	·7	·181	·008	·002
3·8	1·378	2·2	·610	·6	·145	·007	·001
3·7	1·330	2·1	·562	·5	·109		
3·6	1·282	2·0	·514	·4	·075		
3·5	1·234	1·9	·466	·3	·057		

LOSS OF NITROGEN BY EVAPORATION OF NH_3 WITH METAPHOSPHORIC ACID.

Parts per 100,000.

Volume evaporated.	N as NH_3.	Loss of N.	Volume evaporated.	N as NH_3.	Loss of N.	Volume evaporated.	N as NH_3.	Loss of N.
c. c. 100	8·2	·482	c. c. 100	5·1	·352	c. c. 100	2·1	·192
,,	8·1	·477	,,	5·0	·347	,,	2·0	·186
,,	8·0	·473	,,	4·9	·343	,,	1·9	·180
,,	7·9	·469	,,	4·8	·338	,,	1·8	·173
,,	7·8	·465	,,	4·7	·334	,,	1·7	·167
,,	7·7	·461	,,	4·6	·329	,,	1·6	·161
,,	7·6	·456	,,	4·5	·324	,,	1·5	·154
,,	7·5	·452	,,	4·4	·319	,,	1·4	·148
,,	7·4	·448	,,	4·3	·315	,,	1·3	·142
,,	7·3	·444	,,	4·2	·310	,,	1·2	·136
,,	7·2	·440	,,	4·1	·305	,,	1·1	·129
,,	7·1	·435	,,	4·0	·301	,,	1·0	·123
,,	7·0	·431	,,	3·9	·296	,,	·9	·117
,,	6·9	·427	,,	3·8	·291	,,	·8	·111
,,	6·8	·423	,,	3·7	·286	250	·7	·088
,,	6·7	·419	,,	3·6	·281	,,	·6	·073
,,	6·6	·414	,,	3·5	·277	,,	·5	·061
,,	6·5	·410	,,	3·4	·272	500	·4	·049
,,	6·4	·406	,,	3·3	·267	,,	·3	·036
,,	6·3	·402	,,	3·2	·261	1000	·2	·024
,,	6·2	·398	,,	3·1	·255	,,	·1	·012
,,	6·1	·394	,,	3·0	·249	,,	·09	·011
,,	6·0	·389	,,	2·9	·242	,,	·08	·010
,,	5·9	·385	,,	2·8	·236	,,	·07	·008
,,	5·8	·381	,,	2·7	·230	,,	·06	·007
,,	5·7	·377	,,	2·6	·223	,,	·05	·006
,,	5·6	·373	,,	2·5	·217	,,	·04	·005
,,	5·5	·368	,,	2·4	·211	,,	·03	·004
,,	5·4	·364	,,	2·3	·205	,,	·02	·002
,,	5·3	·360	,,	2·2	·198	,,	·01	·001
,,	5·2	·356						

Loss of Nitrogen by Evaporation of NH_3 with Sulphurous Acid.

Parts per 100,000.

NH_3.	Loss of N.	NH_3.	Loss of N.	NH_3.	Loss of N.	NH_3.	Loss of N.	NH_3.	Loss of N.	NH_3.	Loss of N.
6·0	1·727	4·8	1·451	3·6	·977	2·4	·503	1·2	·250	·09	·014
5·9	1·707	4·7	1·411	3·5	·937	2·3	·463	1·1	·238	·08	·013
5·8	1·688	4·6	1·372	3·4	·898	2·2	·424	1·0	·226	·07	·012
5·7	1·668	4·5	1·332	3·3	·858	2·1	·384	0·9	·196	·06	·010
5·6	1·648	4·4	1·293	3·2	·819	2·0	·345	·8	·166	·05	·009
5·5	1·628	4·3	1·253	3·1	·779	1·9	·333	·7	·136	·04	·007
5·4	1·609	4·2	1·214	3·0	·740	1·8	·321	·6	·106	·03	·006
5·3	1·589	4·1	1·174	2·9	·700	1·7	·309	·5	·077	·02	·004
5·2	1·569	4·0	1·135	2·8	·661	1·6	·297	·4	·062	·01	·003
5·1	1·549	3·9	1·095	2·7	·621	1·5	·285	·3	·047	·009	·001
5·0	1·530	3·8	1·056	2·6	·582	1·4	·274	·2	·032		
4·9	1·490	3·7	1·016	2·5	·542	1·3	·262	·1	·017		

LOSS OF NITROGEN BY EVAPORATION OF NH$_3$ WITH METAPHOSPHORIC ACID.

Parts per 100,000.

Volume evaporated.	NH$_3$.	Loss of N.	Volume evaporated.	NH$_3$.	Loss of N.	Volume evaporated.	NH$_3$.	Loss of N
cm.^{3}			cm.^{3}			cm.^{3}		
100	10·0	·483	100	6·3	·354	100	2·7	·200
,,	9·9	·480	,,	6·2	·351	,,	2·6	·195
,,	9·8	·476	,,	6·1	·348	,,	2·5	·190
,,	9·7	·473	,,	6·0	·345	,,	2·4	·184
,,	9·6	·469	,,	5·9	·341	,,	2·3	·179
,,	9·5	·466	,,	5·8	·337	,,	2·2	·174
,,	9·4	·462	,,	5·7	·333	,,	2·1	·169
,,	9·3	·459	,,	5·6	·330	,,	2·0	·164
,,	9·2	·455	,,	5·5	·326	,,	1·9	·158
,,	9·1	·452	,,	5·4	322	,,	1·8	·153
,,	9·0	·448	,,	5·3	·318	,,	1·7	·148
,,	8·9	·445	,,	5·2	·314	,,	1·6	·143
,,	8·8	·441	,,	5·1	·310	,,	1·5	·137
,,	8·7	·438	,,	5·0	·306	,,	1·4	·132
,,	8·6	·434	,,	4·9	·302	,,	1·3	·127
,,	8·5	·431	,,	4·8	·298	,,	1·2	·122
,,	8·4	·428	,,	4·7	·294	,,	1·1	·117
,,	8·3	·424	,,	4·6	·291	,,	1·0	·112
,,	8·2	·421	,,	4·5	·287	250	·9	·096
,,	8·1	·417	,,	4·4	·283	,,	·8	·080
,,	8·0	·414	,,	4·3	·279	,,	·7	·070
,,	7·9	·410	,,	4·2	·275	,,	·6	·060
,,	7·8	·407	,,	4·1	·271	500	·5	·050
,,	7·7	·403	,,	4·0	·267	,,	·4	·040
,,	7·6	·400	,,	3·9	·262	,,	·3	·030
,,	7·5	·396	,,	3·8	·257	1000	·2	·020
,,	7·4	·393	,,	3·7	·252	,,	·1	·010
,,	7·3	·389	,,	3·6	·247	,,	·09	·009
,,	7·2	·386	,,	3·5	·242	,,	·08	·008
,,	7·1	·382	,,	3·4	·236	,,	·07	·007
,,	7·0	·379	,,	3·3	·231	,,	·06	·006
,,	6·9	·375	,,	3·2	·226	,,	·05	·005
,,	6·8	·372	,,	3·1	·221	,,	·04	·004
,,	6·7	·368	,,	3·0	·216	,,	·03	·003
,,	6·6	·365	,,	2·9	·211	,,	·02	·002
,,	6·5	·361	,,	2·8	·205	,,	·01	·001
,,	6·4	·358						

ESTIMATION OF NITROGEN AS NITRATES BY SPRENGEL'S METHOD (FOR WATERS CONTAINING MORE THAN 1 PART OF N IN 100,000.

No. of cm.^{3} of yellow solution equal to the standard 100 cm.^{3}	Nitrogen as Nitrates.		No. of cm.^{3} of yellow solution equal to the standard 100 cm.^{3}	Nitrogen as Nitrates.	
	Parts per 100,000.	Grains per gallon.		Parts per 100,000.	Grains per gallon.
100	1·00	0·70	50	2·00	1·40
95	1·05	0·74	48	2·08	1·46
90	1·11	0·78	46	2·17	1·52
85	1·18	0·83	45	2·22	1·55
80	1·25	0·88	44	2·23	1·56
78	1·28	0·90	42	2·38	1·67
76	1·32	0·92	40	2·50	1·75
75	1·33	0·93	38	2·63	1·84
74	1·35	0·95	36	2·78	1·95
72	1·39	0·97	35	2·86	2·00
70	1·43	1·00	34	2·94	2·06
68	1·47	1·03	32	3·13	2·19
66	1·51	1·06	30	3·33	2·33
65	1·54	1·08	28	3·57	2·50
64	1·55	1·09	26	3·85	2·70
62	1·61	1·13	25	4·00	2·80
60	1·67	1·17	24	4·17	2·92
58	1·72	1·20	22	4·55	3·19
56	1·78	1·25	20	5·00	3·50
55	1·82	1·27	18	5·55	3·89
54	1·85	1·30	16	6·25	4·38
52	1·92	1·34	15	6·67	4·67

TABLE OF HARDNESS. (50 cm.^{3} of water used.)

Volume of Soap Solution.	$CaCO_3$ per 100,000.	Degrees of Hardness.*	Volume of Soap Solution.	$CaCO_3$ per 100,000.	Degrees of Hardness.
cm.^{3}			cm.^{3}		
0·7	0·00	0·00	4·4	5·14	3·60
0·8	0·16	0·11	·5	5·29	3·70
0·9	0·32	0·22	·6	5·43	3·80
1·0	0·48	0·34	·7	5·57	3·90
·1	0·63	0·44	·8	5·71	4·00
·2	0·79	0·55	·9	5·86	4·10
·3	0·95	0·67	5·0	6·00	4·20
·4	1·11	0·78	·1	6·14	4·30
·5	1·27	0·89	·2	6·29	4·40
·6	1·43	1·00	·3	6·43	4·50
·7	1·56	1·09	·4	6·57	4·60
·8	1·69	1·18	·5	6·71	4·70
·9	1·82	1·27	·6	6·86	4·80
2·0	1·95	1·37	·7	7·00	4·90
·1	2·08	1·46	·8	7·14	5·00
·2	2·21	1·55	·9	7·29	5·10
·3	2·34	1·64	6·0	7·43	5·20
·4	2·47	1·73	·1	7·57	5·30
·5	2·60	1·82	·2	7·71	5·40
·6	2·73	1·91	·3	7·86	5·50
·7	2·86	2·00	·4	8·00	5·60
·8	2·99	2·09	·5	8·14	5·70
·9	3·12	2·18	·6	8·29	5·80
3·0	3·25	2·28	·7	8·43	5·90
·1	3·38	2·37	·8	8·57	6·00
·2	3·51	2·46	·9	8·71	6·10
·3	3·64	2·55	7·0	8·86	6·20
·4	3·77	2·64	·1	9·00	6·30
·5	3·90	2·73	·2	9·14	6·40
·6	4·03	2·82	·3	9·29	6·50
·7	4·16	2·91	·4	9·43	6·60
·8	4·29	3·00	·5	9·57	6·70
·9	4·43	3·10	·6	9·71	6·80
4·0	4·57	3·20	·7	9·86	6·90
·1	4·71	3·30	·8	10·00	7·00
·2	4·86	3·40	·9	10·15	7·11
·3	5·00	3·50	8·0	10·30	7·21

* Each degree of hardness indicates 1 grain of $CaCO_3$ per gallon.

TABLE OF HARDNESS—*continued.*

Volume of Soap Solution.	$CaCO_3$ per 100,000.	Degrees of Hardness.	Volume of Soap Solution.	$CaCO_3$ per 100,000.	Degrees of Hardness.
cm.^{3}			cm.^{3}		
8·1	10·45	7·32	12·1	16·59	11·61
·2	10·60	7·42	·2	16·75	11·73
·3	10·75	7·53	·3	16·90	11·83
·4	10·90	7·63	·4	17·06	11·94
·5	11·05	7·74	·5	17·22	12·05
·6	11·20	7·84	·6	17 38	12·17
·7	11·35	7·95	·7	17·54	12·28
·8	11·50	8·05	·8	17·70	12·39
·9	11·65	8·16	·9	17·86	12·50
9·0	11·80	8·26	13·0	18·02	12·61
·1	11·95	8·37	·1	18·17	12·72
·2	12·11	8·48	·2	18·33	12·83
·3	12·26	8·58	·3	13·49	12·94
·4	12·41	8·69	·4	18·65	13·06
·5	12·56	8·79	·5	18·81	13·17
·6	12·71	8·90	·6	18·97	13·28
·7	12·86	9·00	·7	19·13	13·39
·8	13·01	9·11	·8	19·29	13·50
·9	13·16	9·21	·9	19·44	13·61
10·0	13·31	9·32	14·0	19·60	13·72
·1	13·46	9·42	·1	19·76	13·83
·2	13·61	9·53	·2	19·92	13·94
·3	13·76	9·63	·3	20·08	14·06
·4	13·91	9·74	·4	20·24	14·17
·5	14·06	9·84	·5	20·40	14·28
·6	14·21	9·95	·6	20·56	14·39
·7	14·37	10·06	·7	20·71	14·50
·8	14·52	10·16	·8	20·87	14·61
·9	14·68	10·28	·9	21·03	14·72
11·0	14·84	10·39	15·0	21·19	14·83
·1	15·00	10·50	·1	21·35	14·95
·2	15·16	10·6	·2	21·51	15·06
·3	15·32	10·72	·3	21·68	15·18
·4	15·48	10·84	·4	21·85	15·30
·5	15·63	10 94	·5	22·02	15·41
·6	15·79	11·05	·6	22·18	15 53
·7	15 95	11·17	·7	22·35	15·65
·8	16·11	11·28	·8	22·52	15·76
·9	16·27	11·39	·9	22·69	15·88
12·0	16·43	11·50	16·0	22·86	16·00

CLARK'S TABLE OF HARDNESS OF WATER.

Degrees of Hardness.	Measures of Soap Solution.	Differences for the next 1° of Hardness.	Degrees of Hardness.	Measures of Soap Solution.	Differences for the next 1° of Hardness.
0 (distilled water)	1·4	1·8	8	17·5	1·9
1	3·2	2·2	9	19·4	1·9
2	5·4	2·2	10	21·3	1·8
3	7·6	2·0	11	23·1	1·8
4	9·6	2·0	12	24·9	1·8
5	11·6	2·0	13	26·7	1·8
6	13·6	2·0	14	28·5	1·8
7	15·6	1·9	15	30·3	1·7
			16	32·0	..

Each measure equals 10 grains, the quantity of water operated upon equals 1000 grains, and each "degree of hardness" indicates 1 grain of calcic carbonate per gallon.

Grams per litre × 70 = grains per gallon.
Grains per gallon × ·014286 = grams per litre.
Parts per 100,000 × ·7 = grains per gallon.
Grains per gallon ÷ ·7 = parts per 100,000.

Table showing the Absorption of CO_2 in 5 cm.^{3} of HCl, S.G. 1·125, for an Evolution of 1 to 100 cm.^{3}.

Evolved.	Absorbed.	Evolved.	Absorbed.	Evolved.	Absorbed.
1	1·85	35	5·16	68	5·59
2	2·00	36	5·17	69	5·61
3	2·16	37	5·18	70	5·62
4	2·31	38	5·20	71	5·64
5	2·47	39	5·21	72	5·65
6	2·62	40	5·23	73	5·66
7	2·78	41	5·24	74	5·68
8	2·93	42	5·25	75	5·69
9	3·09	43	5·26	76	5·71
10	3·24	44	5·27	77	5·72
11	3·40	45	5·28	78	5·73
12	3·55	46	5·30	79	5·75
13	3·71	47	5·31	80	5·76
14	3·86	48	5·32	81	5·78
15	4·02	49	5·34	82	5·79
16	4·17	50	5·35	83	5·80
17	4·33	51	5·36	84	5·82
18	4·48	52	5·37	85	5·83
19	4·64	53	5·38	86	5·85
20	4·79	54	5·40	87	5·86
21	4·95	55	5·41	88	5·87
22	4·96	56	5·43	89	5·89
23	4·97	57	5·44	90	5·90
24	4·98	58	5·45	91	5·92
25	5·00	59	5·47	92	5·93
26	5·03	60	5·48	93	5·94
27	5·04	61	5·50	94	5·96
28	5·06	62	5·51	95	5·97
29	5·07	63	5·52	96	5·99
30	5·09	64	5·54	97	6·00
31	5·10	65	5·55	98	6·01
32	5·11	66	5·57	99	6·03
33	5·13	67	5·58	100	6·04
34	5·14				

Table showing the Absorption of Nitrogen Gas in 60 cm.^{3} of Liquid (50 cm.^{3} of Hypochlorite Solution and 10 cm.^{3} of Water, S.G. 1·1.

Evolved.	Absorbed.	Evolved.	Absorbed.	Evolved.	Absorbed.
1	·06	35	·91	68	1·73
2	·08	36	·93	69	1·76
3	·11	37	·96	70	1·78
4	·13	38	·98	71	1·81
5	·16	39	1·01	72	1·83
6	·18	40	1·03	73	1·86
7	·21	41	1·06	74	1·88
8	·23	42	1·08	75	1·91
9	·26	43	1·11	76	1·93
10	·28	44	1·13	77	1·96
11	·31	45	1·16	78	1·98
12	·33	46	1·18	79	2·01
13	·36	47	1·21	80	2·03
14	·38	48	1·23	81	2·06
15	·41	49	1·26	82	2·08
16	·43	50	1·28	83	2·11
17	·46	51	1·31	84	2·13
18	·48	52	1·33	85	2·16
19	·51	53	1·36	86	2·18
20	·53	54	1·38	87	2·21
21	·56	55	1·41	88	2·23
22	·58	56	1·43	89	2·26
23	·61	57	1·46	90	2·28
24	·63	58	1·48	91	2·31
25	·66	59	1·51	92	2·33
26	·68	60	1·53	93	2·36
27	·71	61	1·56	94	2·38
28	·73	62	1·58	95	2·41
29	·76	63	1·61	96	2·43
30	·78	64	1·63	97	2·46
31	·81	65	1·66	98	2·48
32	·83	66	1·68	99	2·51
33	·86	67	1·71	100	2·53
34	·88				

(D) *GAS ANALYSIS.*

The measurement of gases. See Section Eudiometry, pp. 291 *et seq.*

Reagents required in Gas Analysis by Bunsen's Method.

Bullets of fused $CaCl_2$.

Bullets of sodium hydrogen phosphate or sodium sulphate; made from the partially dehydrated salts, and free from Cl.

Bullets of KHO.

Bullets of $MnO_2 + Fe_2O_3$; made by introducing a paste of the mixed oxides into an oiled bullet mould and drying on a water bath, then moistening several times with syrupy phosphoric acid.

Bullets of coke; made by heating to redness a mixture of coal and coke *in situ* in the mould.

Bullets of papier-maché.

Concentrated Cu_2Cl_2 in dilute HCl.

Pyrogallic acid.

Nordhausen sulphuric acid; made by placing ordinary Nordhausen acid in a retort and distilling the evolved SO_3 into another portion of the acid kept in the receiver.

Absolute alcohol.

Oxygen gas.

Direct Estimation of Gases by Bunsen's Method.

Group **A**: HCl, HBr, HI.—The gaseous mixture is first dried by means of $CaCl_2$, and the hydro-halogen then absorbed by means of a bullet of sodium phosphate or sulphate.

Group B: CO_2, SO_2, H_2S.—If CO_2 is present without SO_2 or H_2S, absorb with a soft bullet of KHO. If SO_2 or H_2S is present, absorb this with a bullet of $MnO_2 + Fe_2O_3$ before determining CO_2 with KHO. H_2S or SO_2 may be absorbed by a soft bullet of KHO, the bullet dissolved in water previously boiled and secluded from air while cooling, and the H_2S or SO_2 estimated in the solution with standard solution of I.

Group C: O, NO, CO, CnH_{2n} hydrocarbons, CnH_{2n+2} hydrocarbons (except CH_4).

O is absorbed with a papier-maché bullet soaked in alkaline pyrogallate. NO is converted into NO_2 and N_2O_3 by adding excess of O. The nitrous compounds are then absorbed with a KHO bullet, and the excess of O removed with pyrogallate. CO is absorbed, after previous removal of O and CO_2, with a papier-maché bullet soaked with a concentrated solution of Cu_2Cl_2 in dilute HCl; or the gas may be absorbed at 100° C. with a KHO bullet. C_nH_{2n} hydrocarbons are absorbed with a coke bullet soaked in Nordhausen sulphuric acid. C_nH_{2n+2} and CnH_{2n} hydrocarbons may be absorbed by introducing absolute alcohol into the eudiometer, but it is necessary to make a correction for the column of alcohol and for the tension of its vapour.

Estimation of Gases by Explosion in Bunsen's Method.

The correct volume of oxygen required to give complete combustion and a sufficiently moderated explosion:—

Gas.	Volume of Combustible Gas.	Volumes of Oxygen.
H	1	1·5
CO	1	1·5
CH_4	1	5
Gases containing C_2 in molecule .	1	10
Gases containing C_3 in molecule .	1	18
Gases containing C_4 in molecule .	1	25

TABLE SHOWING THE VOLUME BEFORE AND AFTER EXPLOSION.

Name of Gas.	Volume of Combustible Gas.	Volumes of O consumed.	Contraction.	Volumes of CO produced.
H	1	·5	1·5	0
CO	1	·5	·5	1
CH_4	1	2·	2·	1
C_2H_2	1	2·5	1·5	2
C_2H_4	1	3·	2·	2
C_2H_6	1	3·5	2·5	2
C_3H_6	1·	4·5	2·5	3
C_3H_8	1	5·	3·	3
C_4H_8	1·	6·	3·	4
C_4H_{10}	1	6·5	3·5	4

The following formulæ are used in calculating the component gases after explosion and absorption.

If $A =$ original mixture,
$C =$ contraction,
$D = CO_2$ produced.

If $x = H$ and $y = N$; $x = \frac{2C}{3}$ and $y = A - x = \frac{3A - 2C}{3}$.

If $x = \mathbf{CO}$ and $y = \mathbf{N}$; $x = D$ and $y = A - D$.

If $x = \mathbf{H}$, $y = \mathbf{CO}$, $z = \mathbf{N}$; $x = \frac{2C - D}{3}$, $y = D$, $z = A - x - y = \frac{3A - 2C - 2D}{3}$.

If $x = \mathbf{H}$, $y = \mathbf{CH_4}$, $z = \mathbf{N}$; $x = \frac{2C - 4D}{3}$, $y = D$, $z = A - x - y = \frac{3A - 2C + D}{3}$.

If $x = \mathbf{CO}$, $y = \mathbf{CH_4}$, $z = \mathbf{N}$; $x = \frac{4D - 2C}{3}$, $y = \frac{2C - D}{3}$, $z = A - D$.

If $x = \mathbf{H}$, $y = \mathbf{C_2H_6}$, $z = \mathbf{N}$; $x = \frac{4C - 5D}{6}$, $y = \frac{D}{2}$, $z = A - x - y = \frac{3A - 2C + D}{3}$.

If $x = \mathbf{CO}$, $y = \mathbf{C_2H_6}$, $z = \mathbf{N}$; $x = \frac{5D - 4C}{3}$, $y = \frac{2C - D}{3}$, $z = A - x - y = \frac{3A - 4D + 2C}{3}$.

If $x = \mathbf{H}$, $y = \mathbf{CO}$, $z = \mathbf{CH_4}$; $x = A - D$, $y = \frac{3A - 2C + D}{3}$, $z = A - x - y = \frac{2C - 3A + 2D}{3}$.

If $x = \mathbf{H}$, $y = \mathbf{CO}$, $z = \mathbf{C_2H_6}$; $x = \frac{3A + 2C - 4D}{6}$, $y = \frac{3A - 2C + D}{3}$, $z = A - x - y = \frac{2C - 3A + 2D}{6}$.

If $x = \mathbf{CO}$, $y = \mathbf{CH_4}$, $z = \mathbf{C_2H_6}$; $x = \frac{3A - 2C + 4D}{3}$, $y = \frac{3A + 2C - 4D}{3}$, $z = A - x - y = D - A$.

If $x = \mathbf{H}$, $y = \mathbf{CH_4}$, $z = \mathbf{C_2H_2}$; $x = \frac{5A - 2C - D}{2}$, $y = 2C - 3A$, $z = A - x - y = \frac{D - 2C + 3A}{2}$.

If $x = \mathbf{H}$, $y = \mathbf{CH_4}$, $z = \mathbf{C_2H_6}$, $\mathbf{E}$ = volume absorbed by alcohol; $x = A - D + E$, $y = D - 2E$, $z = E$.

If $x = \mathbf{H}$, $y = \mathbf{CO}$, $z = \mathbf{C_3H_8}$; $x = \frac{3A + 4C - 5D}{9}$, $y = \frac{3A - 2C + D}{3}$, $z = A - x - y = \frac{2C - 3A + 2D}{9}$.

If $x = \mathbf{CO}$, $y = \mathbf{CH_4}$, $z = \mathbf{C_3H_8}$; $x = \frac{3A - 2C + D}{3}$, $y = \frac{3A + 4C - 5D}{6}$, $z = A - x - y = \frac{D - A}{2}$.

If $x = \mathbf{CO}$, $y = \mathbf{C_2H_6}$, $z = \mathbf{C_3H_8}$; $x = \frac{3A - 2C + D}{3}$, $y = \frac{3A + 4C - 5D}{3}$, $z = A - x - y = \frac{4D - 3A - 2C}{3}$.

If $x = \mathbf{CH_4}$, $y = \mathbf{C_2H_6}$, $z = \mathbf{C_3H_8}$, E = absorption by alcohol; $x = A - E$, $y = 4A - 2C + 2E$, $z = 2C - 4A - E$.

If $x = \mathbf{H}$, $y = \mathbf{CO}$, $z = \mathbf{C_4H_{10}}$; $x = \frac{A + 2C - 2D}{4}$, $y = \frac{3A - 2C + D}{3}$, $z = A - x - y = \frac{2C + 2D - 3A}{12}$.

If $n = \mathbf{N}$, $w = \mathbf{H}$, $x = \mathbf{CO}$, $y = \mathbf{C_2H_6}$, $z = \mathbf{C_4H_{10}}$: determine E = alcohol absorption in part of gas; take another portion, add O and explode, then measure contraction and CO_2; residue (contains N and the excess of O), add excess of H, explode, and measure contraction.

If G = excess of O and N, v = excess of O, n = N, C′ contraction for explosion with H; $G = v + n$, $C' = 3v$, $v = \frac{C'}{3}$,

$$n = G - v = \frac{3G - C'}{3}, \quad \text{and} \quad w = \frac{2C - D - 3E}{3};$$

$$x = \frac{3A - 2C + D - 3n}{3}, \; y = \frac{3A - 2C - 2D + 12E - 3n}{6},$$

$$z = \frac{2C - 3A + 2D - 6E + 3n}{6}.$$

With the newer forms of apparatus for analysis of gases the methods are essentially the same as when Bunsen's original process is used, but the reagents are usually employed in the liquid form, and the calculations are much simplified. The use of Keiser's gas apparatus depends upon the determination of the weights of the volumes of mercury equal to the various gaseous volumes. When the pressure and temperature remain constant during the analysis, the weights of mercury are in direct proportion to the gaseous volume; but if the temperature and pressure alter during the analysis, and it is necessary to reduce to 0° C. and 760 mm., the following formula is employed. If W = grams of Hg, D = sp. gr. of Hg at t° C. of observation, H = barometer, h = tension of aqueous vapour, V′ = reduced gas volume in cm.^{3},

$$V' = \frac{W(H - h)}{D(1 + \cdot 00367\,t)\,760}.$$

For technical purposes gas analyses are often carried out in simple forms of apparatus, such as Allen's, Orsat's, Hempel's, the nitrometer, &c. In such cases where a separate instrument can be set apart for the testing of a particular substance, it saves time if the gas-measuring tube is so marked as to give the weight in mg. corresponding to the volume of gas, or to show percentages direct when a fixed weight of the substance under assay is used. The following table is of use for such purposes.

Substance.	Basis to which percentage is calculated.	Method used.	Gas evolved.	1 cm.^{3} of Gas = mg. of Basis.
Organic bodies ..	N	Dumas	N	1·254
Ammonium salts	N	NaBrO	N	1·285*
" "	NH_3	"	N	1·561*
Urine	Urea	"	N	2·952*
Limestone, soils, charcoal, &c. ..	CO_2	With HCl	CO_2	1·966
	$CaCO_3$	"	CO_2	4·468
Pyrolusite	MnO_2	With H_2O_2	O	3·882
Bleaching powder	Cl	"	O	1·5835
$KMnO_4$	O	"	O	·715
$NaNO_3$	$NaNO_3$	Nitrometer	NO	3·805
Nitrous bodies ..	N_2O_3	"	NO	1·701
	HNO_3	"	NO	2·820
	HNO_3 36°B	"	NO	5·330
	$NaNO_3$	"	NO	3·805
Nitroglycerol, dynamite, &c...	Trinitro-glycerol	"	NO	3·387
	N	"	NO	·6267
Nitrocellulose, pyroxylin ..	N	"	NO	·6267

* Corrected for incompleteness of reaction.

For calculation of gaseous volumes, see Section VII., pp. 291 *et seq.*

Waldo

ASSAY TABLE FOR LEAD ORES.

400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.		
	cwts.	qrs.	lbs.		cwts.	qrs.	lbs.		cwts.	qrs.	lbs.		cwts.	qrs.	lbs.
60	3	0	0	93	4	2	16	126	6	1	5	159	7	3	22
61	3	0	5	94	4	2	22	127	6	1	11	160	8	0	0
62	3	0	11	95	4	3	0	128	6	1	16	161	8	0	5
63	3	0	16	96	4	3	5	129	6	1	22	162	8	0	11
64	3	0	22	97	4	3	11	130	6	2	0	163	8	0	16
65	3	1	0	98	4	3	16	131	6	2	5	164	8	0	22
66	3	1	5	99	4	3	22	132	6	2	11	165	8	1	0
67	3	1	11	100	5	0	0	133	6	2	16	166	8	1	5
68	3	1	16	101	5	0	5	134	6	2	22	167	8	1	11
69	3	1	22	102	5	0	11	135	6	3	0	168	8	1	16
70	3	2	0	103	5	0	16	136	6	3	5	169	8	1	22
71	3	2	5	104	5	0	22	137	6	3	11	170	8	2	0
72	3	2	11	105	5	1	0	138	6	3	16	171	8	2	5
73	3	2	16	106	5	1	5	139	6	3	22	172	8	2	11
74	3	2	22	107	5	1	11	140	7	0	0	173	8	2	16
75	3	3	0	108	5	1	16	141	7	0	5	174	8	2	22
76	3	3	5	109	5	1	22	142	7	0	11	175	8	3	0
77	3	3	11	110	5	2	0	143	7	0	16	176	8	3	5
78	3	3	16	111	5	2	5	144	7	0	22	177	8	3	11
79	3	3	22	112	5	2	11	145	7	1	0	178	8	3	16
80	4	0	0	113	5	2	16	146	7	1	5	179	8	3	22
81	4	0	5	114	5	2	22	147	7	1	11	180	9	0	0
82	4	0	11	115	5	3	0	148	7	1	16	181	9	0	5
83	4	0	16	116	5	3	5	149	7	1	22	182	9	0	11
84	4	0	22	117	5	3	11	150	7	2	0	183	9	0	16
85	4	1	0	118	5	3	16	151	7	2	5	184	9	0	22
86	4	1	5	119	5	3	22	152	7	2	11	185	9	1	0
87	4	1	11	120	6	0	0	153	7	2	16	186	9	1	5
88	4	1	16	121	6	0	5	154	7	2	22	187	9	1	11
89	4	1	22	122	6	0	11	155	7	3	0	188	9	1	16
90	4	2	0	123	6	0	16	156	7	3	5	189	9	1	22
91	4	2	5	124	6	0	22	157	7	3	11	190	9	2	0
92	4	2	11	125	6	1	0	158	7	3	16	191	9	2	5

ASSAY TABLE FOR LEAD ORES—*continued.*

400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.			400 grains of Ore give Grains of Metal.	Weight of Metal in a Ton of Ore.		
	cwts.	qrs.	lbs.		cwts.	qrs.	lbs.		cwts.	qrs.	lbs.		cwts.	qrs.	lbs.
192	9	2	11	225	11	1	0	258	12	3	16	291	14	2	5
193	9	2	16	226	11	1	5	259	12	3	22	292	14	2	11
194	9	2	22	227	11	1	11	260	13	0	0	293	14	2	16
195	9	3	0	228	11	1	16	261	13	0	5	294	14	2	22
196	9	3	5	229	11	1	22	262	13	0	11	295	14	3	0
197	9	3	11	230	11	2	0	263	13	0	16	296	14	3	5
198	9	3	16	231	11	2	5	264	13	0	22	297	14	3	11
199	9	3	22	232	11	2	11	265	13	1	0	298	14	3	16
200	10	0	0	233	11	2	16	266	13	1	5	299	14	3	22
201	10	0	5	234	11	2	22	267	13	1	11	300	15	0	0
202	10	0	11	235	11	3	0	268	13	1	16	301	15	0	5
203	10	0	16	236	11	3	5	269	13	1	22	302	15	0	11
204	10	0	22	237	11	3	11	270	13	2	0	303	15	0	16
205	10	1	0	238	11	3	16	271	13	2	5	304	15	0	22
206	10	1	5	239	11	3	22	272	13	2	11	305	15	1	0
207	10	1	11	240	12	0	0	273	13	2	16	306	15	1	5
208	10	1	16	241	12	0	5	274	13	2	22	307	15	1	11
209	10	1	22	242	12	0	11	275	13	3	0	308	15	1	16
210	10	2	0	243	12	0	16	276	13	3	5	309	15	1	22
211	10	2	5	244	12	0	22	277	13	3	11	310	15	2	0
212	10	2	11	245	12	1	0	278	13	3	16	311	15	2	5
213	10	2	16	246	12	1	5	279	13	3	22	312	15	2	11
214	10	2	22	247	12	1	11	280	14	0	0	313	15	2	16
215	10	3	0	248	12	1	16	281	14	0	5	314	15	2	22
216	10	3	5	249	12	1	22	282	14	0	11	315	15	3	0
217	10	3	11	250	12	2	0	283	14	0	16	316	15	3	5
218	10	3	16	251	12	2	5	284	14	0	22	317	15	3	11
219	10	3	22	252	12	2	11	285	14	1	0	318	15	3	16
220	11	0	0	253	12	2	16	286	14	1	5	319	15	3	22
221	11	0	5	254	12	2	22	287	14	1	11	320	16	0	0
222	11	0	11	255	12	3	0	288	14	1	16	321	16	0	5
223	11	0	16	256	12	3	5	289	14	1	22	322	16	0	11
224	11	0	22	257	12	3	11	290	14	2	0	323	16	0	16

TABLE SHOWING THE WEIGHT OF SILVER TO THE TON OF ORE, CORRESPONDING TO THE WEIGHT IN GRAINS OBTAINED FROM 400 GRAINS OF MINERAL.

If 400 grains of Ore give Fine Metal.	1 Ton of Ore will Yield.			If 400 grains of Ore give Fine Metal.	1 Ton of Ore will Yield.		
	oz.	dwts.	grs.		oz.	dwts.	grs.
·001	0	1	15	·200	16	6	16
·002	0	3	6	·300	24	10	0
·003	0	4	21	·400	32	13	8
·004	0	6	12	·500	40	16	16
·005	0	8	4	·600	49	0	0
·006	0	9	19	·700	57	3	8
·007	0	11	10	·800	65	6	16
·008	0	13	1	·900	73	10	0
·009	0	14	16	1·000	81	13	8
·010	0	16	8	2·000	163	6	16
·020	1	12	16	3·000	245	0	0
·030	2	9	0	4·000	326	13	8
·040	3	5	8	5·000	408	6	16
·050	4	1	16	6·000	490	0	0
·060	4	18	0	7·000	571	13	8
·070	5	14	8	8·000	653	6	16
·080	6	10	16	9·000	735	0	0
·090	7	7	0	10·000	816	13	8
·100	8	3	8				

Weight of Silver to the Ton of Lead Ore corresponding to the Weight in Grains obtained from an Assay on 1 oz. of Mineral.

Grs.	Oz.	Dwts.	Grains.	Grs.	Oz.	Dwts.	Grains.
·001	..	1	11·840	·600	44	16	0·000
·002	..	2	23·680	·700	52	5	8·000
·003	..	4	11·520	·800	59	14	16·000
·004	..	5	23·360	·900	67	4	0·000
·005	..	7	11·200	1·000	74	13	8·000
·006	..	8	23·040	2·000	149	6	16·000
·007	..	10	10·880	3·000	224	0	0·000
·008	..	11	22·720	4·000	298	13	8·000
·009	..	13	10·560	5·000	373	6	16·000
·010	..	14	22·400	6·000	448	0	0·000
·020	1	9	20·800	7·000	522	13	8·000
·030	2	4	19·200	8·000	597	6	16·000
·040	2	19	17·600	9·000	672	0	0·000
·050	3	14	16·000	10·000	746	13	8·000
·060	4	9	14·400	20·000	1493	6	16·000
·070	5	4	12·800	30·000	2240	0	0·000
·080	5	19	11·200	40·000	2986	13	8·000
·090	6	14	9·600	50·000	3733	6	16·000
·100	7	9	8·000	60·000	4480	0	0·000
·200	14	18	16·000	70·000	5226	13	8·000
·300	22	8	0·000	80·000	5973	6	16·000
·400	29	17	8·000	90·000	6720	0	0·000
·500	37	6	16·000	100·000	7466	13	8·000

TABLE FOR THE CONVERSION OF CARATS INTO EQUIVALENTS.

Carats.	Decimal Equivalent.	Carat Grains.	Decimal Equivalent.
		1	10·417
1	41·667	2	20·833
2	88·333	3	31·250
3	125·000	4	41·667
4	166·667		
5	208·333	**Eighths.**	**Decimal Equivalent.**
6	250·000	1	1·302
7	291·667	2	2·604
8	333·333	3	3·906
9	375·000	4	5·208
10	416·667	5	6·510
11	458·222	6	7·812
12	500·000	7	9·115
13	541·667	8	10·417
14	583·333		
15	625·000		
16	666·667	**Excess Grains.**	**Decimal Equivalent.**
17	708·333		
18	750·000	1	0·174
19	791·667	2	0·347
20	833·333	3	0·521
21	875·000	4	0·694
22	916·667	5	0·868
23	958·222	6	1·042
24	1000·000	7	1·215
		7·5	1·302

Table showing the Quantity of Lead necessary for the Cupellation of Alloys of Silver and Copper.

Silver in Thousandths.	Lead to be added to 1 gram of Alloy.	Silver in Thousandths.	Lead to be added to 1 gram of Alloy.
1000	0·3 gram	500	16 to 17 grams.
950	3 grams	400	
900	7 ,,	300	
800	10 ,,	200	
700	12 ,,	100	
600	14 ,,		

Table showing the Corrections to be applied in Determinations of Silver by Cupellation of Alloys of Silver and Copper.

True Value.	Value by Cupellation.	Differences.	True Value.	Value by Cupellation.	Differences.
1000	998·97	1·03	600	595·32	4·68
950	947·50	2·50	550	545·32	4·68
900	896·60	4·00	500	495·32	4·68
850	845·85	4·15	400	396·05	3·95
800	795·70	4·30	300	297·40	2·60
750	745·48	4·52	200	197·47	2·53
700	695·25	4·75	100	99·12	·88
650	645·29	4·71			

TABLE SHOWING THE CORRECTIONS TO BE APPLIED IN DETERMINATIONS OF GOLD BY CUPELLATION.

Gold (True Value in Thousandths).	Gold (Value Found).	Differences.	Gold (True Value in Thousandths).	Gold (Value Found).	Differences.
900	900·25	+ ·25	400	399·50	− ·50
800	800·50	·50	300	299·50	·50
700	700·00	·00	200	199·50	·50
600	600·00	·00	100	99·50	·50
500	499·50	− ·50			

TABLE SHOWING THE QUANTITY OF LEAD NECESSARY FOR THE CUPELLATION OF ALLOYS OF GOLD AND COPPER.

Value in Gold in Thousandths.	Quantity of Lead necessary to remove the Copper.	Value in Gold in Thousandths.	Quantity of Lead necessary to remove the Copper.
1000	1 part	500	26 parts
900	10 parts	400	34 "
800	16 "	300	
700	22 "	200	
600	24 "	100	

(F) *INDIRECT ANALYSIS.*

RULES FOR INDIRECT ANALYSIS.

Indirect determination of K and Na as sulphates :—

Multiply the sulphuric anhydride (SO_3) found by 2·17775, deduct from the product the sum of the sulphates, and multiply the remainder by 4·4072; the product expresses the quantity of the sodium sulphate.

Indirect determination of K and Na as chlorides :—

Multiply the quantity of chlorine in the mixture by 2·1029, deduct from the product the sum of the chlorides, and multiply the remainder by 3·6288; the product expresses the quantity of sodium chloride present in the mixture.

Indirect determination of Sr and Ca as carbonates :—

Multiply the carbonic anhydride (CO_2) found by 3·3523, deduct from the product the sum of the carbonates, and multiply the difference by 2·10526: the product gives the weight of the calcium carbonate.

Indirect determination of Cl and Br, as AgBr + AgCl, and then as AgCl :—

Multiply the decrease of weight by 4·22025 to find the amount of silver bromide present in the mixture.

Indirect determination of Ba and Ca as sulphates :—

Let w = substance taken ;
$x = BaSO_4$ present in the substance ;
$y = CaSO_4$ „ „ „ ;

then

$$x + y = w. \qquad [1]$$

When the whole of SO_3 is converted into $BaSO_4$, x will remain unaltered, but y will be increased in the proportion $\frac{233}{136}$; therefore

$$x + \frac{233}{136} y = w', \qquad [2]$$

where w' is the weight of the resulting $BaSO_4$.

Now, subtracting equation [1] from [2], we get $\frac{233}{136}y - y = w' - w$; that is,

$$y\left(\frac{233}{136} - 1\right) = w' - w,$$

hence

$$y = \frac{w' - w}{\frac{233}{136} - 1},$$

from which the percentage of y can be found.

When the mixture consists of K_2SO_4 and Na_2SO_4, $x = Na_2SO_4$, $y = K_2SO_4$; therefore

$$x + y = w, \qquad [1]$$

and

$$\frac{233}{142}x + \frac{233}{174}y = w'. \qquad [2]$$

Multiplying [1] by $\frac{233}{142}$, we get

$$\frac{233}{142}x + \frac{233}{142}y = \frac{233}{142}w. \qquad [3]$$

Now, subtracting [3] from [2],

$$\frac{233}{174}y - \frac{233}{142}y = w' - \frac{233}{142}w;$$

and

$$y = \frac{w' - \frac{233}{142}w}{\frac{233}{174} - \frac{233}{142}} = w' - \frac{233}{142}w;$$

therefore

$$y = \frac{w' - \frac{233}{142}w}{\frac{233}{174} - \frac{233}{142}}.$$

Generally, when $a =$ coefficient of x, $b =$ coefficient of y

$$a\,x + b\,y = w' \; [2];$$
$$a\,x + a\,y = a\,w \; [3].$$

Subtracting [3] from [2],

$$b\,y - a\,y = w' - a\,w, \text{ and } y = \frac{w' - a\,w}{b - a}.$$

The principle is applicable to any mixture of two substances containing one radical, either positive or negative common to both, and capable of easy estimation.

TABLE FOR THE ESTIMATION OF VARIOUS SUBSTANCES BY WEIGHING THE CO_2 EVOLVED.

Substance.	Sought.	Factor.	Logarithm.
Sodium carbonate (crystallised).	$Na_2CO_3 + 10H_2O$	6·5000	0,81291
Potassium carbonate ..	K_2CO_3	3·1409	0,49705
Manganese peroxide ..	MnO_2	·9886	$\bar{1}$,99502
Acetic acid	$C_2H_4O_2$	1·364	0,13481
Nitric anhydride ..	N_2O_5	1·228	0,08920
Hydrochloric acid ..	HCl	·830	$\bar{1}$,91908
Sulphuric anhydride ..	SO_3	1·1137	0,05576

See also Table for mixtures of NaCl and KCl on p. 413, and Table for mixtures of Na_2CO_3 and K_2CO_3 on p. 412.

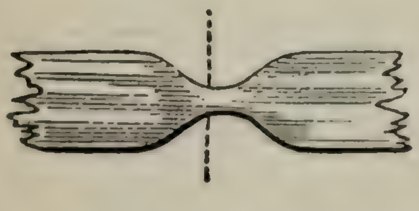
(G) *MISCELLANEOUS.*

CHEMICAL MANIPULATION.

To bend Glass Tube.—Heat the tube in the broad flame of an ordinary fish-tail or bat's-wing burner until it begins to bend by its own weight. Then it may easily be bent to the required shape without creasing if removed from the flame. In bending wide tubes (say ·5 inch diameter), it is better either to heat a considerable length of them to redness in a charcoal or combustion furnace, and then make the required bend, or to heat successive portions in the large blow-pipe flame, and bend each portion, and so make the bend by degrees.

To draw a Piece of Tube out to a Jet.—Heat the glass in the blow-pipe flame, at the point where the jet is required, while slowly turning it round, until it thickens. When it is heated equally all round, withdraw it from the flame and draw it out to the required jet. Next cut off at the middle of the narrow part, and heat the end in the flame for a moment to fuse the sharp edges.

To mend a Test-tube.—Test-tubes frequently break at the bottom, and may then be mended as follows:—Fasten a piece of scrap tube on to the broken end by making both soft in the flame, and immediately draw off the test-tube as near as possible to the broken end. The fine point of the blow-pipe flame must then be directed upon the narrowed portion so as to produce an extremely narrowed neck as shown, and the two portions must then be severed by drawing off at the narrowed point. This leaves a small lump of glass; to remove this, heat the lump in the flame until it is soft, and blow it out to a small bubble at the end of the tube. Now heat the whole end in a large blow-pipe flame, or in the flame of a good Bunsen burner, keeping it turning all the time, until it shrinks in regularly to a flattened hemisphere. Then blow gently into the tube, when the end expands into a uniformly thin hemispherical bottom. The



small tubes of hard glass for use in blow-pipe analysis are made in the same way.

To cut Glass Tube.—To cut off ordinary quill tubing, nick the tube with the edge of a sharp three-cornered file (if the file is sharp, one stroke across the glass is sufficient), and then placing the thumbs one on each side of the nick, give the hands a quick movement as if to bend the tube, which then easily snaps off. Thick, wide tubing is cut by filing a deeper nick into it some distance round, and wrapping it in a towel before attempting to break it. The end of a combustion tube is trimmed by the pincers. The tube is held in the left hand, and the pincers in the right; one of the handles being between the thumb and forefinger, and the other between the two last fingers. By moving the latter handle and at the same time smartly turning the wrist, a nibbling motion is given to the points of the pincers, easily enabling the operator to level the end of the tube, which must afterwards be fused for a moment in the blow-pipe flame.

Thin tubes cannot be cut by the file; it is better to lead a crack round them by a hot glass rod. Broken flasks and bottles may often be put to valuable use by cutting them in the same way. A crack is started by the pincers, or by pressing a hot rod upon them, and then touching the heated part with the wet finger; this is then led round the vessel in any direction by keeping the end of the hot rod a little in advance of the crack.

To grind Glass.—The ends of thick tubes may be ground level upon a stone with turpentine; the addition of sand, or, still better, emery powder, increases the action.

To fuse a Platinum Wire into a Tube.—Draw out the tube to a narrow jet and insert the clean end of the wire, then heat the end in the flame until the glass shrinks and clasps the wire. Cool slowly.

To make a T-piece.—The glass for this purpose must be soft; lead glass, however, is not the best. Cut two pieces of the same tube into convenient lengths, and close the end of one. Then heat the closed piece at one point near the middle by the point of the flame. When the spot is well heated, blow out a bubble, and break this by a tap upon the table. This should leave a hole about as large as the diameter of the tube. Now heat the projecting edges of this hole and the end of the second piece of tube in the same flame, keeping the unclosed end of the first tube stopped by the finger. When the glass is hot, bring the end of the second tube and the sides of the hole together, withdraw the glass from the flame and blow gently into the tube. This gives an imperfectly made joint. Now direct the point of a hot flame upon the joint until the two portions forming the juncture fuse together and shrink in. While the tube is hot, blow in gently to expand the shrunken part; go round the juncture in this way until the line of division disappears. Cool slowly. In the same way two pieces of tube are joined in a straight line, by heating the two ends, bringing them together, and then going round the joint till it disappears.

To clean Vessels.—A mop made by fixing a bit of sponge to the end of a thick wire is very useful in cleaning test-tubes. Care must be taken that no projecting portion of the wire is left to break the bottom of the tube. According to the solubility of the substance defiling the vessel to be cleaned, a little common acid or alkali may be used: but in very many cases water alone suffices. Vessels contaminated with substances of the nature of pitch, tar, &c., are cleaned by heating a little strong sulphuric acid in them. To clean evaporating basins, beakers, &c., a little sea sand (which has no sharp edges) or furnace ashes may be used to scour them. Platinum crucibles are cleansed by gentle scouring with sea sand and the finger. Sometimes a little acid sulphate of potassium, fused in them, will remove obstinate impurities. Aqua regia should never be used to clean platinum. All vessels must finally be rinsed with distilled water.

To remove Stoppers that have become fixed.—Heat the neck of the bottle by pouring hot water round it, or by rotating it once quickly in a flame; this expands the neck and allows the stopper to be withdrawn; or tap the stopper gently with some wooden object until it is loose. Sometimes a stopper may be extracted by holding the bottle in the hand, inserting the flat part of the stopper into a crevice of a door, &c., and turning the bottle. Stoppers may often be removed by soaking in hot water or by placing a little oil round them, which after a time sinks in and loosens them.

To cleanse Mercury.—Leave the mercury in a flat dish with dilute nitric acid, containing nitrate of mercury, and stir occasionally for some hours.

Sulphuric acid diluted with twice its weight of water may also be used.

For gas analysis, mercury is cleansed and dried by placing it in a funnel tube, stoppered at top and bottom, together with strong sulphuric acid. The mercury is introduced at the top and drawn off at the bottom. It is often advisable to filter mercury through a filter, made by bending a piece of writing paper in the usual way and making a small pin hole at the bottom. Faraday recommends that before being filtered, the mercury should be shaken in a bottle with a little powdered lump sugar, previously slightly damped by breathing several times into the bottle containing it. This removes scum.

Faraday's Cap Cement.—This is of great use in a laboratory. It is made by melting together five parts of resin and one part of yellow beeswax, and then adding one part of Venetian red or red ochre. The cement should be stirred as long as possible while cooling.

A soft Cement is made by taking yellow beeswax one part, turpentine one part, and a little Venetian red to colour.

Linseed Meal is useful as a lute in some cases. Mix up the meal to a paste with water, and apply to the joint. The use of milk, lime water, or weak glue in the preparation of this lute, increases its strength.

Cements.—A useful cement is made by dissolving the best glue in acetic acid; and for mending glass articles, a good cement is made by mixing white of egg with quicklime into a paste.

GLOSSARY OF THE MOST IMPORTANT MINERALS, GIVING THE FORMULÆ, HARDNESS, SPECIFIC GRAVITY, AND BEHAVIOUR WITH ACIDS.

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$Al_2O_3.3SiO_2+Na_2O.3SiO_2$	I Albite	6	2·6–2·67	Triclin.
$RO.R_2O_3.4SO_3.24H_2O$	S Alum	2–2·5	1·75–1·9	Tess.
$C_{10}H_8O$	S Amber	2–2·5	1·0–1·1	Irreg.
$Al_2O_3.3SiO_2+Na_2O.SiO_2+2H_2O$	S Analcime	5·5	2·1–2·25	Tess.
$Al_2O_3.SiO_2$	I Andalusite	7–7·5	3·1–3·2	Rhomb.
$PbO.SO_3$	S Anglesite	3	6·2–6·35	Rhomb.
$CaO.SO_3$	I Anhydrite	3–3·5	2·8–3·0	Rhomb.
$Al_2O_3.SiO_2+CaO.SiO_2$	S Anorthite	6	2·7–2·76	Triclin.
C, H, N, O, &c.	— Anthracite	2–2·5	1·4–1·7	Irreg.
Ag_2S	S Argentite	2–2·5	7·0–7·4	Tess.
$CaO.CO_2$	S Arragonite	3·5–4·0	2·9–3·0	Rhomb.
C, H, N, O, &c.	— Asphaltum	2	1·1–1·2	Irreg.
$(Ca.Mg.Fe)\ O.SiO_2$	I Augite	5–6	3·0–3·5	Monoclin.
$(Al.B)_2O_3+2(Ca.Fe)O.SiO_2$	I Axinite	6·5–7	3·2–3·3	Triclin.
$3CuO.2CO_2+H_2O$	S Azurite	3·5–4·2	3·7–3·8	Monoclin.
$BaO.SO_3$	I Barytes	3–3·5	4·3–4·7	Rhomb.
$Al_2O_3.3SiO_2+3(GlO.SiO_2)$	I Beryl	7·5–8	2·6–2·8	Hexag.
$Al_2O_3.SiO_2+3(Mg.K_2.Fe)O.SiO_2$	S Biotite	2·5–3	2·85–2·9	Hexag.
CH_2	— Bitumen		·7–·9	Liquid.
$Na_2O.2B_2O_3+10H_2O$	S Borax	2–2·5	1·7–1·8	Monoclin.

GLOSSARY OF THE MOST IMPORTANT MINERALS—*continued.*

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$3Cu_2S.Fe_2S_3$	S Bornite	3	4·9–5·1	Tess.
C, H, N, O, &c.	— Brown coal ..		·5–1·5	Irreg.
$2Al_2O_3.P_2O_5+5H_2O$	S Calaite	6	2·6–2·8	Irreg.
$CaO.CO_3$	S Calcite	3	2·6–2·8	Hexag., Rhombo.
SnO_2	I Cassiterite ..	6–7	6·8–7·0	Tetrag.
$SrO.SO_3$	I Celestine	3–3·5	3·9–4·0	Rhomb.
$PbO.CO_2$	S Cerussite	3–3·5	6·4–6·6	Rhomb.
$2(2RO.SiO_2)+Al_2O_3.3H_2O$	S Chlorite	1–1·5	2·78–2·96	Hexag.
$(Fe.Mg)O.(Cr.Al)_2O_3$	I Chromite	5·5	4·4–4·5	Tesseral.
$2(Mg.Fe)O.SiO_2$	S Chrysolite ..	6·5–7	3·3–3·5	Rhombic.
K_2O, Al_2O_3, H_2O, Fe_2O_3, CaO, SiO_2, &c.	— Clay		1·8–2·7	Irreg.
CoS_2+CoAs	S Cobaltine	5·5	6·0–6·3	Tess.
$2Al_2O_3.3SiO_2+2(MgO.SiO_2)$	I Cordierite	7–7·5	2·5–2·7	Rhomb.
Al_2O3	I Corundum ..	9	3·9–4·2	Hex., Rhombo.
Cu_2O	S Cuprite	3·5–4	5·7–6·0	Tess.
$Al_2O_3.SiO_2$	I Cyanite	5–7	3·5–3·7	Triclin.
$CuO.SO_3+5H_2O$	S Cyanose	2·5	2·2–2·3	Triclin.
$CaAO.B_2O_3+CaO.2SiO_2+H_2O$	S Datholite	5–5·5	2·9–3·0	Monoclin.
C	I Diamond	10	3·5–3·6	Tess.
$CaO.CO_2+MgO.CO_2$	S Dolomite	3·5–4·5	2·85–2·95	Hex., Rhombo.

Glossary of the Most Important Minerals—*continued*.

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$Al_2O_3.3SiO_2+3(GlO.SiO_2)$	I Emerald	7·5–8·0	2·6–2·8	Hexag.
$MgO(FeO).SiO_2$	I Enstatite	4·5–5·5	3·1–3·3	Rhomb.
$3(Al_2O_3.SiO_2+CaO.SiO_2)+CaO.H_2O$	S Epidote	6–7	3·2–3·5	Monoclin.
$3CoO.As_2O_3+8H_2O$	S Erythrine.. ..	1·5–2·5	2·9–3·0	Monoclin.
CaF_2	S Fluorite	4	3·1–3·2	Tess.
Al_2O_3, (Fe, Mg, Ca, H,)O, SiO_2, &c.	— Fullers' earth ..	1–1·5	1·8–2·0	Irreg.
PbS	S Galena	2·5	7·2–7·6	Tess.
$2ZnO.SiO_2+H_2O$	S Galmei	5	3·3–3·5	Rhomb.
$3(Mg.Ca)O.2SiO_2+(Al.Fe)_2O_3.SiO_2$	S Garnet	6·5–7·5	3·5–4·3	Tess.
$ZnO.SO_3+7H_2O$	S Goslarite	2–2·5	2–2·1	Rhomb.
$Fe_2O_3.H_2O$	S Götheite	5–5·5	3·8–4·4	Rhomb.
C	I Graphite	·5–1	1·9–2·2	Hexag. or Monocl.
$BaO.Al_2O_3+5(H_2O.SiO_2)$	S Harmotome ..	4·5	2·3–2·5	Rhomb.
$2(Al_2O_3.SiO_2+Na_2O.SiO_2)+CaO.SO_3$	S Hauyne	5–5·5	2·4–2·5	Tess.
$Al_2O_3.3SiO_2+CaO.3SiO_2+5H_2O$	S Heulandite ..	3·5–4	2·1–2·2	Monoclin.
$(Mg.Fe, Ca)O.SiO_2$	I Hornblende ..	5–6	2·9–3·4	Monoclin.
$6(2RO.SiO_2)+2Al_2O_3.3SiO_2$	S Idocrase	6·5	3·35–3·45	Tetrag.
$FeO.TiO_2+xFe_2O_3$	S Ilmenite	5–6	4·3–5·0	Hex., Rhombo.

GLOSSARY OF THE MOST IMPORTANT MINERALS—*continued.*

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$H_2O.Al_2O_3+H_2O.2SiO_2$	S Kaolin	1	2·2	Irreg.
$Al_2O_3.2SiO_2+RO.SiO_2$	S Labradorite	6	2·6–2·74	Triclin.
SiO_2, SO_3, CaO, Al_2O_3, Na_2O, &c.	S Lapis-lazuli	5·5	2·3–2·42	Tess.
$Al_2O_3.SiO_2+Li_2O.SiO_2$	S Lepidolite	2–3	2·5–3·0	Monocl., Rhomb.
$Al_2O_3.3SiO_2+K_2O.SiO_2$	S Leucite	5·5–6	2·4–2·5	Tess.
$FeAs_2$	S Leucopyrite	5–5·5	7·0–7·4	Rhomb.
$Fe_2O_3.SiO_2+3(2RO.SiO_2)+H_2O$	S Lievrite	5·5–6	3·9–4·2	Rhomb.
$FeO.Fe_2O_3$	S Magnetite	5·5–6·5	4·9–5·2	Tess.
$(CuO.H_2O+CuO.CO_2)$	S Malachite	3·5–4	3·6–4·0	Monoclin.
$FeO.SO_3+7H_2O$	S Melanterite	2	1·8–1·9	Monoclin.
$3(3PbO.As_2O_5)+PbCl_2$	S Mimetesite	3·5–4·0	7·19–7·25	Hexag.
FeS_2+FeAs_2	S Mispickel	5·5–6·0	6·0–6·2	Rhomb.
MoS	S Molybdenite	1–1·5	4·6–4·9	Hexag.
$Al_2O_3.SiO_2+K_2O.SiO_2$	I Muscovite	2–3	2·8–3·1	Rhomb.
$Al_2O_3.2SiO_2+Na_2O.SiO_2+2H_2O$	S Natrolite	5–5·5	2·17–2·26	Rhomb.
$Na_2O.CO_2+10H_2O$	S Natron	1–1·5	1·4–1·5	Monoclin.
$Al_2O_3.2SiO_2+RO.SiO_2$	S Nepheline	5·5–6	2·58–2·64	Hexag.
$K_2O.N_2O_5$	S Nitre	2	1·9–2·0	Rhomb.
Al_2O_3, MgO, K_2O, Na_2O, SiO_2, &c.	I Obsidian	6–7	2·2–2·6	Irreg.
$2(Al_2O_3.3SiO_2)+2(Na_2O.CaO).3SiO_2$	I Oligoclase	6	2·64–2·68	Triclin.

GLOSSARY OF THE MOST IMPORTANT MINERALS—*continued.*

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$4CuO.As_2O_5+H_2O$	S Olivenite	3	4·1–4·6	Rhomb.
$SiO_2.3H_2O$	I Opal	5·5–6·5	2–2·2	Irreg.
$Al_2O_3.3SiO_2+K_2O.3SiO_2$	I Orthoclase	6	2·53–2·58	Monoclin.
Al_2O_3, $(Ca.Fe.Mg.Na_2)O$, Fe_2O_3, SiO_2, &c.	I Pitchstone	5·5–6·0	2·2–2·3	Irreg.
$Al_2O_3.SiO_2+2(CaO.SiO_2)+H_2O$	S Prehnite	6–7	2·8–3·0	Rhomb.
$3Ag_2S.As_2S_3$	S Proustite		5·5–5·6	Rhombo.
Al_2O_3, MgO, K_2O, Na_2O, SiO_2, &c.	I Pumice	5	2·2	Irreg.
FeS_2	S Pyrites	6–6·5	4·9–5·2	Tess.
$3(3PbO.P_2O_5)+PbCl_2$	S Pyromorphite	3·5–4·0	6·9–7·0	Hexag.
$5FeS.Fe_2S_3$	S Pyrrhotine	3·5–4·5	4·5–4·6	Hexag.
SiO_2	I Quartz	7	2·5–2·8	Hexag.
AsS	S Realgar	1·5–2	3·4–3·6	Monoclin.
TiO_2	I Rutile	6–6·5	4·2–4·3	Tetrag.
NH_4Cl	S Sal-ammoniac	1·5–2	1·5–1·6	Tess.
$B_2O_3+3H_2O$	S Sassoline	1	1·4–1·5	Triclin.
$CaO.WO_3$	S Scheelite	4–4·5	5·9–6·2	Tetrag.
$Al_2O_3.2SiO_2+CaO.SiO_2+3H_2O$	S Scolezite	5–5·5	2·2–2·3	Monoclin.
$3MgO.2SiO_2+2H_2O$	S Serpentine	3–3·5	2·5–2·7	
$FeO.CO_2$	S Siderite	3·5–4·5	3·7–3·9	Hex., Rhombo.
$CoAs_2$	S Smaltine	5·5	6·4–7·3	Tess.

GLOSSARY OF THE MOST IMPORTANT MINERALS—*continued.*

I = insoluble in or unaffected by acids; S = soluble in or decomposed by acids.

Formula.	Name.	Hardness.	Specific Gravity.	Crystalline System.
$ZnO.CO_2$	S Smithsonite	5	3·3–3·5	Rhomb.
ZnS	S Sphalerite	3·5–4	3·9–4·2	Tess. and Tetra.
$CaO.2SiO_2+CaO.2TiO_2$	S Sphene	5–5·5	3·4–3·6	Monoclin.
$MgO.Al_2O_3$	I Spinel	8	3·4–4·1	Tess.
$(Al.Fe)_2O_3.SiO_2+(Fe.Mg)O.SiO_2$	S Staurolite	7	3·5–3·8	Rhomb.
$Al_2O_3.3SiO_2+CaO.3SiO_2+6H_2O$	S Stilbite	3·5–4	2·1–2·2	Rhomb.
$SrO.CO_2$	S Strontianite	3·5	3·6–3·8	Rhomb.
S	S Sulphur	1·5–2·5	1·9–2·1	Rhomb.
$3(MgO.SiO_2)+H_2O.SiO_2$	I Talc	1	2·6–2·8	Rhomb. or Monocl.
$4(Cu_2.Ag, Fe, Zn, Hg)S.Sb_2S_3$	S Tetrahedrite	3–4	4·5–5·2	Tess. and Tetrahed.
$Na_2O.SO_3$	S Thenardite	2·5	2·6–2·7	Rhomb.
$RAl_2S_2O_8+5H_2O$	S Thomsonite	5–5·5	2·3–2·4	Rhomb.
$5(Al_2O_3.SiO_2)+Al_2F_6.SiF_4$	I Topaz	8	3·4–3·6	Rhomb.
B_2O_3, MgO, CaO, $(Na.K)_2O$, SiO_2, &c.	I Tourmaline	6·5–7·5	3–3·3	Rhombo.
$3FeO.P_2O_5+8H_2O$	S Vivianite	2	2·6–2·7	Monoclin.
$Mn(Ca.Ba.K_2)O.Mn_2O_3+3H_2O$	S Wad	3	2·3–3·7	Irreg.
$3Al_2O_3.2P_2O_5+12H_2O$	S Wavellite	3·5–4	2·3–2·5	Rhomb.
$BaO.CO_2$	S Witherite	3–3·5	4·2–4·3	Rhomb.
$FeO.MnO.WO_3$	S Wolfram	5–5·5	7·1–7·5	Monoclin.

SECTION X.—ALCOHOL.

Determination of Alcohol.—When no other body than water is present the strength is obtained directly from the sp. gr. by reference to the tables, p. 483.

When other bodies are present, take a measured vol. of the mixtures at 60° F. (say 50 cm.^{3}) and dilute it to about three vol. (say 150 cm.^{3}) with water. If any volatile acids are present add a slight excess of caustic soda. Distil over nearly $\frac{2}{3}$ of the total vol. (say about 98 cm.^{3}), mix, bring to 60° F., and dilute exactly to 100 cm.^{3} with distilled water at 60° F. Mix and determine by the table, p. 483. The per cent. found has, of course, to be doubled. In the case of high strengths of spirit dilute to 4 vol., and distil over 3 vol.

The strength may be determined approximately by simple evaporation. Take a measured volume at 60° F. (say 100 cm.^{3}), evaporate off alcohol, make up "extract" to the same volume as at first with water at 60° F.

$$\frac{\text{Sp. gr. of original liquid}}{\text{Sp. gr. of extract}} = \text{sp. gr. of the alcohol evaporated.}$$

The tables, p. 483, are those used by the Inland Revenue in the British Isles. Tralles' tables are used in the United States of America. *V.* pp. 490–497.

Formulæ for Conversion of Alcoholic Strength

$$\text{Let } D = \text{density} = \text{sp. gr.}\ \frac{60^\circ \text{ F.}}{60^\circ \text{ F.}}$$

W = grams of absolute alcohol per 100 grams
V = cm.^{3} „ „ „ 100 cm.^{3}
Y = grams „ „ „ „ „
P = cm.^{3} of proof spirit „ „ „
grs. ℥ = grains per fl. ℥;

$$\text{then } W = \frac{V \times 7938}{D} = \frac{P \times \cdot 4529}{D} = \frac{Y}{D}$$

$$V = WD \times 1{\cdot}260 = Y \times 1{\cdot}260 = P \times {\cdot}5706$$
$$Y = WD = V \times {\cdot}7938 = P \times {\cdot}4529$$
$$P = WD \times 2{\cdot}208 = V \times 1{\cdot}7525 = Y \times 2{\cdot}208$$

grs. ℥ = $Y \times 4{\cdot}3756$. (*Proceed to p.* 498.)

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY.

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *under* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent *under* Proof.
1·0000	0·00	0·00	100·00	·9850	9·36	11·61	79·65
·9995	0·26	0·33	99·42	·9845	9·71	12·05	78·90
·9990	0·53	0·66	98·84	·9840	10·08	12·49	78·10
·9985	0·79	0·99	98·26	·9835	10·46	12·96	77·30
·9980	1·06	1·34	97·66	·9830	10·85	13·43	76·46
·9975	1·37	1·73	96·97	·9825	11·23	13·90	75·64
·9970	1·69	2·12	96·29	·9820	11·62	14·37	74·82
·9965	2·00	2·51	95·60	·9815	12·00	14·84	74·00
·9960	2·28	2·86	95·00	·9810	12·38	15·30	73·18
·9955	2·56	3·21	94·40	·9805	12·77	15·77	72·36
·9950	2·83	3·55	93·78	·9800	13·15	16·24	71·54
·9945	3·12	3·90	93·16	·9795	13·54	16·70	70·73
·9940	3·11	4·27	92·50	·9790	13·92	17·17	69·90
·9935	3·71	4·63	91·87	·9785	14·36	17·70	68·97
·9930	4·00	5·00	91·23	·9780	14·82	18·25	68·00
·9925	4·31	5·30	90·55	·9775	15·25	18·78	67·10
·9920	4·62	5·78	89·87	·9770	15·67	19·28	66·20
·9915	4·94	6·17	89·20	·9765	16·08	19·78	65·34
·9910	5·25	6·55	88·50	·9760	16·46	20·24	64·53
·9905	5·56	6·94	87·84	·9755	16·85	20·71	63·72
·9900	5·87	7·32	87·16	·9750	17·25	21·19	62·87
·9895	6·21	7·74	86·43	·9745	17·67	21·69	62·00
·9890	6·57	8·18	86·65	·9740	18·08	22·18	61·13
·9885	6·93	8·63	84·88	·9735	18·46	22·64	60·32
·9880	7·27	9·04	84·15	·9730	18·85	23·10	59·52
·9875	7·60	9·45	83·43	·9725	19·25	23·58	58·67
·9870	7·93	9·86	82·70	·9720	19·67	24·08	57·80
·9865	8·29	10·30	81·96	·9715	20·08	24·58	56·93
·9860	8·64	10·73	81·20	·9710	20·50	25·07	56·06
·9855	9·00	11·17	80·42	·9705	20·92	25·57	55·20

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *under* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *under* Proof.
·9700	21·31	26·04	54·37	·9550	31·62	38·04	33·32
·9695	21·69	26·49	53·57	·9545	31·94	38·40	32·70
·9690	22·08	26·95	52·77	·9540	32·25	38·75	32·08
·9685	22·46	27·40	51·98	·9535	32·56	39·11	31·46
·9680	22·85	27·86	51·18	·9530	32·87	39·47	30·84
·9675	23·23	28·31	50·38	·9525	33·18	39·81	30·24
·9670	23·62	28·77	49·60	·9520	33·47	40·14	29·66
·9665	24·00	29·22	48·80	·9515	33·76	40·47	29·08
·9660	24·38	29·67	48·00	·9510	34·05	40·79	28·52
·9655	24·77	30·13	47·20	·9505	34·29	41·05	28·06
·9650	25·14	30·57	46·44	·9500	34·52	41·32	27·60
·9645	25·50	30·98	45·70	·9495	34·76	41·58	27·13
·9640	25·86	31·40	44·97	·9490	35·00	41·84	26·67
·9635	26·20	31·80	44·27	·9485	35·25	42·12	26·20
·9630	26·53	32·19	43·60	·9480	35·50	42·40	25·70
·9625	26·87	32·58	42·90	·9475	35·75	42·67	25·22
·9620	27·21	32·98	42·20	·9470	36·00	42·95	24·74
·9615	27·57	33·39	41·47	·9465	36·28	43·26	24·20
·9610	27·93	33·81	40·74	·9460	36·56	43·56	23·66
·9605	28·25	34·18	40·10	·9455	36·83	43·87	23·12
·9600	28·56	34·54	39·47	·9450	37·11	44·18	22·58
·9595	28·87	34·90	38·84	·9445	37·39	44·49	22·04
·9590	29·20	35·28	38·18	·9440	37·67	44·79	21·50
·9585	29·53	35·66	37·50	·9435	37·94	45·10	20·96
·9580	29·87	36·04	36·83	·9430	38·22	45·41	20·43
·9575	30·17	36·39	36·23	·9425	38·50	45·71	19·89
·9570	30·44	36·70	35·68	·9420	38·78	46·02	19·36
·9565	30·72	37·02	35·13	·9415	39·05	46·32	18·83
·9560	31·00	37·34	34·57	·9410	39·30	46·59	18·36
·9555	31·31	37·69	33·95	·9405	39·55	46·86	17·88

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *under* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *under* Proof.
·9400	39·80	47·13	17·40	·9250	46·91	54·66	4·20
·9395	40·05	47·40	16·93	·9245	47·14	54·90	3·80
·9390	40·30	47·67	16·46	·9240	47·36	55·13	3·38
·9385	40·55	47·94	15·98	·9235	47·59	55·37	2·97
·9380	40·80	48·21	15·50	·9230	47·82	55·60	2·56
·9375	41·05	48·48	15·04	·9225	48·05	55·83	2·15
·9370	41·30	48·75	14·57	·9220	48·27	56·07	1·74
·9365	41·55	49·02	14·10	·9215	48·50	56·30	1·33
·9360	41·80	49·29	13·63	·9210	48·73	56·54	0·92
·9355	42·05	49·55	13·16	·9205	48·96	56·77	0·50
·9350	42·29	49·81	12·70	·9200	49·16	56·98	0·14
·9345	42·52	50·06	12·27	·9198	49·24	57·06	Proof
·9340	42·76	50·31	11·82			Over Proof.	
·9335	43·00	50·57	11·38	·9195	49·39	57·20	0·25
·9330	43·24	50·82	10·94	·9190	49·64	57·45	0·68
·9325	43·48	51·07	10·50	·9185	49·86	57·69	1·10
·9320	43·71	51·32	10·05	·9180	50·09	57·92	1·51
·9315	43·95	51·58	9·60	·9175	50·30	58·14	1·89
·9310	44·18	51·82	9·20	·9170	50·52	58·36	2·28
·9305	44·41	52·06	8·77	·9165	50·74	58·58	2·66
·9300	44·64	52·29	8·36	·9160	50·96	58·80	3·05
·9295	44·86	52·53	7·94	·9155	51·17	59·01	3·41
·9290	45·09	52·77	7·52	·9150	51·38	59·22	3·78
·9285	45·32	53·01	7·10	·9145	51·58	59·43	4·14
·9280	45·55	53·24	6·70	·9140	51·79	59·63	4·50
·9275	45·77	53·48	6·27	·9135	52·00	59·84	4·87
·9270	46·00	53·72	5·86	·9130	52·23	60·07	5·27
·9265	46·23	53·95	5·45	·9125	52·45	60·30	5·67
·9260	46·46	54·19	5·03	·9120	52·68	60·52	6·07
·9255	46·68	54·43	4·62	·9115	52·91	60·74	6·47

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.
·9110	53·13	60·97	6·86	·8960	59·83	67·53	18·34
·9105	53·35	61·19	7·23	·8955	60·04	67·73	18·70
·9100	53·57	61·40	7·61	·8950	60·26	67·93	19·05
·9095	53·78	61·62	7·99	·8945	60·46	68·13	19·39
·9090	54·00	61·84	8·36	·8940	60·67	68·33	19·74
·9085	54·24	62·07	8·78	·8935	60·88	68·52	20·08
·9080	54·48	62·31	9·20	·8930	61·08	68·72	20·42
·9075	54·71	62·55	9·62	·8925	61·29	68·91	20·77
·9070	54·95	62·79	10·03	·8920	61·50	69·11	21·11
·9065	55·18	63·02	10·44	·8915	61·71	69·30	21·45
·9060	55·41	63·24	10·84	·8910	61·92	69·50	21·79
·9055	55·64	63·46	11·24	·8905	62·14	69·71	22·16
·9050	55·86	63·69	11·64	·8900	62·36	69·92	22·53
·9045	56·09	63·91	12·03	·8895	62·59	70·14	22·91
·9040	56·32	64·14	12·41	·8890	62·82	70·35	23·29
·9035	56·55	64·36	12·80	·8885	63·04	70·57	23·66
·9030	56·77	64·58	13·18	·8880	63·26	70·77	24·02
·9025	57·00	64·80	13·57	·8875	63·48	70·97	24·37
·9020	57·22	65·01	13·92	·8870	63·70	71·17	24·73
·9015	57·42	65·21	14·27	·8865	63·91	71·38	25·09
·9010	57·63	65·41	14·62	·8860	64·13	71·58	25·44
·9005	57·83	65·61	14·97	·8855	64·35	71·78	25·79
·9000	58·05	65·81	15·33	·8850	64·57	71·98	26·15
·8995	58·27	66·03	15·72	·8845	64·78	72·18	26·50
·8990	58·50	66·25	16·11	·8840	65·00	72·38	26·85
·8985	58·73	66·47	16·49	·8835	65·21	72·58	27·19
·8980	58·95	66·69	16·88	·8830	65·42	72·77	27·52
·8975	59·17	66·90	17·25	·8825	65·63	72·96	27·85
·8970	59·39	67·11	17·61	·8820	65·83	73·15	28·19
·8965	59·61	67·32	17·98	·8815	66·04	73·34	28·52

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.
·8810	66·26	73·54	28·87	·8660	72·52	79·12	38·65
·8805	66·48	73·73	29·22	·8655	72·74	79·31	38·99
·8800	66·70	73·93	29·57	·8650	72·96	79·50	39·32
·8795	67·91	74·13	29·92	·8645	73·17	79·68	39·64
·8790	67·13	74·33	30·26	·8640	73·38	79·86	39·96
·8785	67·33	74·52	30·59	·8635	73·58	80·04	40·27
·8780	67·54	74·70	30·92	·8630	73·79	80·22	40·60
·8775	67·75	74·89	31·25	·8625	74·00	80·40	40·91
·8770	67·96	75·08	31·58	·8620	74·23	80·60	41·26
·8765	68·17	75·27	31·90	·8615	74·45	80·80	41·61
·8760	68·38	75·45	32·23	·8610	74·68	81·00	41·96
·8755	68·58	75·64	32·56	·8605	74·91	81·20	42·31
·8750	68·79	75·83	32·89	·8600	75·14	81·40	42·66
·8745	69·00	76·01	33·21	·8595	75·36	81·60	43·00
·8740	69·21	76·20	33·54	·8590	75·59	81·80	43·35
·8735	69·42	76·39	33·86	·8585	75·82	82·00	43·70
·8730	69·63	76·57	34·19	·8580	76·04	82·19	44·04
·8725	69·83	76·76	34·51	·8575	76·25	82·37	44·35
·8720	70·04	76·94	34·84	·8570	76·46	82·54	44·66
·8715	70·24	77·12	35·14	·8565	76·67	82·72	44·97
·8710	70·44	77·29	35·45	·8560	76·88	82·90	45·28
·8705	70·64	77·46	35·76	·8555	77·08	83·07	45·60
·8700	70·84	77·64	36·07	·8550	77·29	83·25	45·90
·8695	71·04	77·82	36·37	·8545	77·50	83·43	46·20
·8690	71·25	78·00	36·69	·8540	77·71	83·60	46·51
·8685	71·46	78·18	37·01	·8535	77·92	83·78	46·82
·8680	71·67	78·36	37·33	·8530	78·12	83·94	47·11
·8675	71·88	78·55	37·65	·8525	78·32	84·11	47·40
·8670	72·09	78·73	37·98	·8520	78·52	84·27	47·70
·8665	72·30	78·93	38·32	·8515	78·72	84·44	47·98

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.
·8510	78·92	84·60	48·27	·8360	84·88	89·39	56·66
·8505	79·12	84·77	48·56	·8355	85·08	89·55	56·93
·8500	79·32	84·93	48·84	·8350	85·27	89·70	57·20
·8495	79·52	85·10	49·13	·8345	85·46	89·84	57·45
·8490	79·72	85·26	49·38	·8340	85·65	89·99	57·71
·8485	79·92	85·42	49·67	·8335	85·85	90·14	57·97
·8480	80·13	85·59	50·00	·8330	86·04	90·29	58·23
·8475	80·33	85·77	50·31	·8325	86·23	90·43	58·48
·8470	80·54	85·94	50·61	·8320	86·42	90·58	58·74
·8465	80·75	86·11	50·91	·8315	86·62	90·73	59·00
·8460	80·96	86·28	51·21	·8310	86·88	90·88	59·26
·8455	81·16	86·45	51·50	·8305	87·00	91·02	59·51
·8450	81·36	86·61	51·78	·8300	87·19	91·17	59·77
·8445	81·56	86·77	52·06	·8295	87·38	91·31	60·02
·8440	81·76	86·93	55·34	·8290	87·58	91·46	60·28
·8435	81·96	87·09	52·62	·8285	87·77	91·60	60·53
·8430	82·15	87·24	52·90	·8280	87·96	91·75	60·79
·8425	82·35	87·40	53·16	·8275	88·16	91·90	61·05
·8420	82·54	87·55	53·43	·8270	88·36	92·05	61·32
·8415	82·73	87·70	53·70	·8265	88·56	92·21	61·60
·8410	82·92	87·85	53·96	·8260	88·76	92·36	61·86
·8405	83·12	88·00	54·23	·8255	88·96	92·51	62·12
·8400	83·31	88·16	54·50	·8250	89·16	92·66	62·38
·8395	83·50	88·31	54·75	·8245	89·35	92·80	62·63
·8390	83·69	88·46	55·02	·8240	89·54	92·94	62·88
·8385	83·88	88·61	55·28	·8235	89·73	93·09	63·13
·8380	84·08	88·76	55·55	·8230	89·92	93·23	63·38
·8375	84·28	88·92	55·83	·8225	90·11	93·36	63·62
·8370	84·48	89·08	56·10	·8220	90·29	93·49	63·84
·8365	84·68	89·24	56·38	·8215	90·46	93·62	64·06

TABLE SHOWING THE STRENGTH OF ALCOHOL BY SPECIFIC GRAVITY—*continued.*

Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.	Sp. Gr. at 60° F.	Per cent. of Alcohol by Wt.	Per cent. of Alcohol by Vol.	Per cent. *over* Proof.
·8210	90·64	93·75	64·30	·8070	95·68	97·27	70·46
·8205	90·82	93·87	64·51	·8065	95·86	97·39	70·67
·8200	91·00	94·00	64·74	·8060	96·03	97·51	70·88
·8195	91·18	94·13	64·96	·8055	96·20	97·62	71·07
·8190	91·36	94·26	65·18	·8050	96·37	97·73	71·26
·8185	91·54	94·38	65·40	·8045	96·53	97·83	71·45
·8180	91·71	94·51	65·62	·8040	96·70	97·94	71·64
·8175	91·89	94·64	65·85	·8035	96·87	98·05	71·83
·8170	92·07	94·76	66·07	·8030	97·03	98·16	72·02
·8165	92·26	94·90	66·30	·8025	97·20	98·27	72·20
·8160	92·44	95·03	66·53	·8020	97·37	98·37	72·40
·8155	92·63	95·16	66·76	·8015	97·53	98·48	72·58
·8150	92·81	95·29	67·00	·8010	97·70	98·59	72·77
·8145	93·00	95·42	67·23	·8005	97·87	98·69	72·95
·8140	93·18	95·55	67·46	·8000	98·03	98·80	73·14
·8135	93·37	95·69	67·70	·7995	98·19	98·89	73·30
·8130	93·55	95·82	67·92	·7990	98·34	98·98	73·47
·8125	93·74	95·95	68·15	·7985	98·50	99·07	73·64
·8120	93·92	96·08	68·38	·7980	98·66	99·16	73·81
·8115	94·10	96·20	68·60	·7975	98·81	99·26	73·97
·8110	94·28	96·32	68·80	·7970	98·97	99·35	74·14
·8105	94·45	96·43	69·00	·7965	99·13	99·45	74·31
·8100	94·62	96·55	69·20	·7960	99·29	99·55	74·5
·8095	94·80	96·67	69·40	·7955	99·45	99·65	74·66
·8090	94·97	96·78	69·61	·7950	99·61	99·75	74·83
·8085	95·14	96·90	69·82	·7945	99·78	99·86	75·01
·8080	95·32	97·02	70·03	·7940	99·94	99·96	75·18
·8075	95·50	97·15	70·25	·7938	absolute	alcohol	75·25

TRALLES' TABLE I.

Per cent. of Alcohol, by Volume.	Specific Gravity of the Liquid at 60° F.	Difference of the Specific Gravities.	Per cent. of Alcohol, by Volume.	Specific Gravity of the Liquid at 60° F.	Difference of the Specific Gravities.	Per cent. of Alcohol, by Volume.	Specific Gravity of the Liquid at 60° F.	Difference of the Specific Gravities.
0	0·9991		34	0·9596	13	68	0·8941	24
1	9976	15	35	9583	13	69	8917	24
2	9961	15	36	9570	13	70	8892	25
3	9947	14	37	9556	14	71	8867	25
4	9933	14	38	9541	15	72	8842	25
5	9919	14	39	9526	15	73	8817	25
6	9906	13	40	9510	16	74	8791	26
7	9893	13	41	9494	16	75	8765	26
8	9881	12	42	9478	16	76	8739	26
9	9869	12	43	9461	17	77	8712	27
10	9857	12	44	9444	17	78	8685	27
11	9845	12	45	9427	17	79	8658	27
12	9834	11	46	9409	18	80	8631	27
13	9823	11	47	9391	18	81	8603	28
14	9812	11	48	9373	18	82	8575	28
15	9802	10	49	9354	19	83	8547	28
16	9791	11	50	9335	19	84	8518	29
17	9781	10	51	9315	20	85	8488	30
18	9771	10	52	9295	20	86	8458	30
19	9761	10	53	9275	20	87	8428	30
20	9751	10	54	9254	21	88	8397	31
21	9741	10	55	9234	20	89	8365	32
22	9731	10	56	9213	21	90	8332	33
23	9720	11	57	9192	21	91	8299	33
24	9710	10	58	9170	22	92	8265	34
25	9700	10	59	9148	22	93	8230	35
26	9689	11	60	9126	22	94	8194	36
27	9679	10	61	9104	22	95	8157	37
28	9668	11	62	9082	22	96	8118	39
29	9657	11	63	9059	23	97	8077	41
30	9646	11	64	9036	23	98	8034	43
31	9634	12	65	9013	23	99	7988	46
32	9622	12	66	8989	24	100	7939	49
33	9609	13	67	8965	24			

TRALLES' TABLE II.

Per cent., by Volume, of absolute Alcohol.	Specific Gravity of the Liquid at 60° F.	Increase of Specific Gravity at the Indicated Temperature *below* 60°.						Decrease of Specific Gravity at the Indicated Temperature *above* 60°.							
		+55°	50°	45°	40°	35°	30°	65°	70°	75°	80°	85°	90°	95°	100°
0	0·9991	4	7	9	9	9	7	1	11	17	24	32	40	50	60
5	9919	4	7	9	10	10	9	1	11	18	25	33	42	51	62
10	9857	5	9	12	14	15	15	6	13	20	29	37	47	57	68
15	9802	6	12	17	21	23	25	7	15	25	34	44	55	67	79
20	9751	8	16	23	29	35	39	9	19	30	41	53	66	79	93
25	9700	10	21	31	39	48	56	11	24	36	50	63	78	93	109
30	9646	13	26	39	51	62	73	14	28	43	59	75	91	108	125
35	9583	16	31	46	61	75	89	17	33	50	68	86	104	122	141
40	9510	18	35	52	70	87	103	18	37	56	75	94	114	136	154
45	9427	19	39	57	76	94	112	20	40	60	80	101	122	143	154
50	9335	20	40	60	80	99	118	21	42	63	84	106	128	150	173
55	9234	21	42	63	84	104	124	22	43	65	87	109	132	155	178
60	9126	22	43	65	86	107	127	22	44	67	90	113	136	159	183
65	9013	22	45	67	88	109	130	22	45	68	92	115	138	162	187
70	8892	22	45	68	90	112	133	23	46	69	93	117	141	165	190
75	8765	23	46	68	91	113	135	23	46	70	94	119	143	167	192
80	8631	23	47	70	92	115	137	23	47	71	96	120	144	169	194
85	8488	23	47	70	93	116	139	24	48	72	96	121	145	170	195
90	8332	24	48	71	94	117	140	24	48	72	97	121	146	171	196

TRALLES' TABLE III.

Per cent. of Alcohol, by Volume.	Specific Gravity of the Liquid, ascertained by Glass Instruments, at the Indicated Temperatures.											
	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
0	·9994	·9997	·9997	·9998	·9997	·9994	·9991	·9987	·9981	·9976	·9970	·9962
5	9924	9926	9926	9925	9925	9922	9919	9915	9909	9903	9897	9889
10	9868	9869	9868	9867	9865	9861	9857	9852	9845	9839	9831	9823
15	9823	9822	9820	9817	9813	9807	9802	9796	9788	9779	9771	9761
20	9786	9782	9777	9772	9766	9759	9751	9743	9733	9723	9713	9701
25	9752	9745	9737	9729	9720	9709	9700	9690	9678	9666	9653	9640
30	9715	9705	9694	9683	9671	9658	9646	9633	9619	9605	9590	9574
35	9668	9655	9641	9627	9612	9598	9583	9567	9551	9535	9518	9500
40	9609	9594	9577	9560	9544	9527	9510	9493	9474	9456	9438	9419
45	9535	9518	9500	9482	9464	9445	9427	9408	9388	9369	9359	9329
50	9449	9431	9413	9393	9374	9354	9335	9315	9294	9274	9253	9232
55	9354	9335	9316	9295	9275	9254	9234	9213	9192	9171	9150	9128
60	9249	9230	9210	9189	9168	9147	9126	9105	9083	9061	9039	9016
65	9140	9120	9099	9078	9056	9034	9013	8992	8969	8947	8924	8901
70	9021	9001	8980	8958	8936	8913	8892	8870	8847	8825	8801	8778
75	8896	8875	8854	8832	8810	8787	8765	8743	8720	8697	8673	8649
80	8764	8743	8721	8699	8676	8653	8631	8609	8585	8562	8538	8514
85	8623	8601	8579	8556	8533	8510	8488	8465	8441	8418	8394	8370
90	8469	8446	8423	8401	8379	8355	8332	8309	8285	8262	8238	8214

TRALLES' TABLE IV.

To be subtracted.						To be added.					
30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
·0005	·0004	·0003	·0002	·0002	·0001	—	·0001	·0002	·0002	·0003	·0004

TRALLES' TABLE V.

To ascertain at any temperature, from the specific gravity, the quantity of absolute alcohol in a liquid expressed in volume centesimally, at the indicated temperature.

Per cent. of Absolute Alcohol in the Liquid as measured.	Specific Gravity of the Liquid, ascertained by Glass Instruments, at the Indicated Temperatures.											
	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
0	·9994	·9997	·9997	·9998	·9997	·9994	·9991	·9987	·9981	·9976	·9970	·9962
5	9924	9926	9926	9926	9925	9922	9919	9915	9909	9903	9897	9889
10	9868	9869	9868	9867	9865	9861	9857	9852	9845	9839	9831	9823
15	9823	9822	9820	9817	9813	9807	9802	9796	9788	9779	9771	9761
20	9786	9782	9777	9772	9766	9759	9751	9743	9733	9722	9711	9700
25	9753	9746	9738	9729	9720	9709	9700	9690	9678	9665	9652	9638
30	9717	9707	9695	9684	9672	9659	9646	9632	9618	9603	9588	9572
35	9671	9658	9644	9629	9614	9599	9583	9566	9549	9532	9514	9495
40	9615	9598	9581	9563	9546	9528	9510	9491	9472	9452	9433	9412
45	9544	9525	9506	9486	9467	9447	9427	9406	9385	9364	9342	9320
50	9460	9440	9420	9399	9378	9356	9335	9313	9290	9267	9244	9221
55	9368	9347	9325	9302	9279	9256	9234	9211	9187	9163	9139	9114
60	9267	9245	9222	9198	9174	9150	9126	9102	9076	9051	9026	9000
65	9162	9138	9113	9088	9063	9038	9013	8988	8962	8936	8909	8882
70	9046	9021	8996	8970	8944	8917	8892	8866	8839	8812	8784	8756
75	8925	8890	8873	8847	8820	8792	8765	8738	8710	8681	8652	8622
80	8798	8771	8744	8716	8688	8659	8631	8602	8573	8544	8514	8483
85	8663	8635	8606	8577	8547	8517	8488	8458	8427	8396	8365	8333
90	8517	8486	8455	8425	8395	8363	8332	8300	8268	8236	8204	8171

TRALLES' TABLE VI.

To be added.						To be subtracted.					
30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
·0005	·0004	·0003	·0002	·0002	·0001	—	·0001	·0002	·0002	·0003	·0004

TRALLES' TABLE VII.

Per cent. of Alcohol, by Volume.	Length of immersed part of Stem.	Distance between Degrees of Scale indicating per cent.	Per cent. of Alcohol, by Volume.	Length of immersed part of Stem.	Distance between Degrees of Scale indicating per cent.	Per cent. of Alcohol, by Volume.	Length of immersed part of Stem.	Distance between Degrees of Scale indicating per cent.
0	9		34	420	13	68	1184	30
1	24	15	35	434	14	69	1215	31
2	39	15	36	449	15	70	1246	31
3	54	15	37	465	16	71	1278	32
4	68	14	38	481	16	72	1310	32
5	82	14	39	498	17	73	1342	32
6	95	13	40	515	17	74	1375	33
7	108	13	41	533	18	75	1409	34
8	121	13	42	551	18	76	1443	34
9	133	12	43	569	18	77	1478	35
10	145	12	44	588	19	78	1514	36
11	157	12	45	608	20	79	1550	36
12	169	12	46	628	20	80	1587	37
13	180	11	47	648	20	81	1624	37
14	191	11	48	669	21	82	1662	38
15	202	11	49	690	21	83	1701	39
16	213	11	50	712	22	84	1740	39
17	224	11	51	735	23	85	1781	41
18	235	11	52	758	23	86	1823	42
19	245	10	53	782	24	87	1866	43
20	356	10	54	806	24	88	1910	44
21	266	10	55	830	24	89	1955	45
22	277	11	56	854	24	90	2002	47
23	288	11	57	879	25	91	2050	48
24	299	11	58	905	26	92	2099	49
25	310	11	59	931	26	93	2150	51
26	321	11	60	957	26	94	2203	53
27	332	11	61	984	27	95	2259	56
28	344	12	62	1011	27	96	2318	59
29	355	11	63	1039	28	97	2380	62
30	367	12	64	1067	28	98	2447	67
31	380	13	65	1096	29	99	2519	72
32	393	13	66	1125	29	100	2597	78
33	407	14	67	1154	29			

TRALLES' TABLE VIII.

To find the true percentage of absolute alcohol by volume, in a liquid at 60° Fahr. from the observed percentage indicated by a glass alcoholometer at any other temperature (degrees Fahr.).

30°	35°	40°	45°	50°	55°	60°	60°	65°	70°	75°	80°	85°
− 0·2	− 0·4	− 0·4	− 0·5	− 0·4	− 0·2	0	0	+ 0·2	+ 0·6	+ 1·0	+ 1·4	+ 1·9
+ 4·6	+ 4·5	+ 4·5	+ 4·5	+ 4·6	+ 4·8	5	5	5·3	5·8	6·2	6·7	7·3
9·1	9·0	9·1	9·2	9·3	9·7	10	10	10·4	11·0	11·6	12·3	13·0
13·0	13·1	13·3	13·5	13·9	14·5	15	15	15·6	16·3	17·1	18·0	19·0
16·5	16·9	17·4	17·8	18·5	19·2	20	20	20·8	21·8	22·8	23·8	24·9
19·9	20·6	21·4	22·2	23·0	24·1	25	25	25·9	27·0	28·2	29·4	30·5
23·5	24·5	25·7	26·6	27·7	28·8	30	30	31·1	32·2	33·4	34·5	35·7
28·0	29·2	30·4	31·6	32·7	33·8	35	35	36·2	37·3	38·4	39·5	40·6
33·0	34·2	35·4	36·7	37·8	39·0	40	40	41·1	42·2	43·3	44·3	45·4
38·4	39·6	40·7	41·8	42·9	43·9	45	45	46·1	47·1	48·2	49·2	50·3
43·7	44·7	45·8	46·9	47·9	49·0	50	50	51·0	52·0	53·0	54·0	55·1
49·0	50·0	51·0	52·0	53·0	54·0	55	55	54·9	56·9	57·9	58·9	59·9
54·2	55·2	56·2	57·1	58·1	59·0	60	60	60·9	61·9	62·9	63·8	64·9
59·4	60·3	61·2	62·2	63·1	64·0	65	65	65·9	66·8	67·7	68·6	69·6
64·6	65·5	66·4	67·3	68·2	69·1	70	70	70·8	71·7	72·6	73·5	74·5
69·8	70·7	71·5	72·4	73·3	74·2	75	75	75·8	76·7	77·6	78·4	79·3
75·0	75·8	76·6	77·5	78·4	79·2	80	80	80·8	81·7	82·4	83·2	84·1
80·3	81·1	81·8	82·6	83·5	84·3	85	85	85·7	86·5	87·3	88·0	88·8
85·6	86·4	87·1	87·9	88·6	89·3	90	90	90·7	91·4	92·0	92·7	93·4

TRALLES' TABLE IX.

To find the true percentage of absolute alcohol by volume, in a liquid of any temperature, from the observed percentage indicated by the glass alcoholometer at the same temperature.

True per cent. of Alcohol, by Volume, at 60° Fahr.	Observed per cent. indicated by the Glass Alcoholometer.										
	30°	35°	40°	45°	50°	55°	65°	70°	75°	80°	85°
0	− 0·2	− 0·4	− 0·4	− 0·5	− 0·4	− 0·2	+ 0·2	+ 0·6	+ 1·0	+ 1·4	+ 1·9
5	+ 4·6	+ 4·5	+ 4·5	+ 4·5	+ 4·6	+ 4·8	5·3	5·8	6·2	6·7	7·3
10	9·1	9·0	9·1	9·2	9·3	9·7	10·4	11·0	11·6	12·3	13·0
15	13·0	13·1	13·3	13·6	14·1	14·5	15·6	16·3	17·1	18·0	19·0
20	16·5	16·9	17·4	17·9	18·5	19·2	20·8	21·8	22·9	23·9	25·0
25	19·8	20·5	21·3	22·2	23·0	24·1	25·9	27·1	28·3	29·5	30·7
30	23·3	24·3	25·5	26·5	27·6	28·8	31·2	32·3	33·5	34·6	35·9
35	27·7	28·9	30·2	31·4	32·6	33·8	36·3	37·5	38·6	39·7	40·9
40	32·5	33·8	35·1	36·5	37·7	38·9	41·2	42·4	43·5	44·6	45·8
45	37·8	39·1	40·3	41·5	42·7	43·8	46·2	47·3	48·5	49·6	50·8
50	43·1	44·2	45·4	46·6	47·7	48·9	51·1	52·2	53·4	54·5	55·6
55	48·3	49·4	50·5	51·6	52·8	53·9	56·1	57·2	58·3	59·4	60·5
60	53·4	54·5	55·6	56·7	57·8	58·9	61·1	62·2	63·3	64·4	65·5
65	58·4	59·5	60·6	61·7	62·8	63·9	66·0	67·1	68·2	69·3	70·4
70	63·5	64·6	65·7	66·8	67·9	69·0	71·0	72·1	73·2	74·3	75·4
75	68·6	69·7	70·7	71·8	72·9	74·0	76·0	77·1	78·2	79·2	80·3
80	73·7	74·8	75·8	76·9	78·0	79·0	81·0	82·1	83·1	84·1	85·2
85	78·8	79·8	80·9	81·9	83·0	84·0	86·0	87·0	88·0	89·0	90·0
90	84·0	85·1	86·1	87·1	88·1	89·1	91·0	91·9	92·8	93·7	94·6

TRALLES' TABLE X.

To find the true percentage of absolute alcohol in a liquid of any temperature, from the observed percentage indicated by a brass alcoholometer at the same temperature.

True per cent. of Alcohol, by Volume.	Observed per cent. indicated by the Brass Alcoholometer.										
	30°	35°	40°	45°	50°	55°	65°	70°	75°	80°	85°
0	− 0·1	− 0·1	− 0·2	− 0·3	− 0·3	− 0·2	+ 0·2	+ 0·5	+ 0·9	+ 1·2	+ 1·7
5	+ 5·0	+ 4·8	+ 4·7	+ 4·8	+ 4·7	+ 4·8	5·2	5·6	6·1	6·5	7·0
10	9·5	9·4	9·4	9·4	9·5	9·7	10·3	10·8	11·4	12·0	12·6
15	13·5	13·5	13·6	13·7	14·0	14·6	15·5	16·2	17·0	17·7	18·6
20	17·0	17·3	17·7	18·1	18·7	19·3	20·7	21·6	22·7	23·7	24·0
25	20·3	20·9	21·6	22·4	23·3	24·2	25·8	26·9	28·1	29·2	30·3
30	23·8	24·7	25·8	26·8	27·8	28·9	31·1	32·2	33·3	34·4	35·5
35	28·2	29·3	30·4	31·6	32·8	33·9	36·2	37·3	38·4	39·5	40·7
40	32·9	34·1	35·4	36·7	37·9	39·0	41·1	42·2	43·4	44·5	45·6
45	38·1	39·3	40·4	41·6	42·7	43·9	46·1	47·2	48·3	49·4	50·5
50	43·4	44·5	45·6	46·7	47·8	48·9	51·1	52·2	53·3	54·4	55·5
55	48·5	49·6	50·7	51·8	52·9	54·0	56·0	57·1	58·2	59·3	60·4
60	53·6	54·6	55·7	56·8	57·8	58·9	61·0	62·1	63·2	64·3	65·3
65	58·6	59·7	60·7	61·8	62·8	63·9	66·0	67·1	68·1	69·2	70·2
70	63·7	64·8	65·8	66·9	67·9	69·0	71·0	72·1	73·1	74·2	75·2
75	68·8	69·8	70·9	71·9	72·9	74·0	76·0	77·0	78·1	79·1	80·1
80	73·9	74·9	75·9	76·9	78·0	79·0	81·0	82·0	83·0	84·0	85·0
85	79·0	80·0	81·0	82·0	83·0	84·0	86·0	87·0	88·0	88·9	89·9
90	84·2	85·2	86·2	87·2	88·1	89·1	90·9	91·9	92·8	93·7	94·5

To calculate the proportion of spirit of any proof strength contained in a sample of known proof strength (weaker).

$$\frac{\text{Per cent. required} \times 100}{\text{Per cent. in sample}} = \left\{\begin{array}{l}\text{vol. of stronger spirit which} \\ \quad\text{will produce or be contained} \\ \quad\text{in 100 vol. of the weaker} \\ \quad\text{spirit.}\end{array}\right.$$

To calculate the per cent. by vol. of water ($= x$) present in adulterated spirits: in brandy, whiskey, rum, which are considered to be adulterated if below 25 under proof. Let N be proof strength of sample.

$$x = \frac{4\,(N - 25)}{3}.$$

In gin, which is considered to be adulterated if below 35 under proof—

$$x = 1 \cdot 54\,(N - 35).$$

TABLE FOR CORRECTION OF SPECIFIC GRAVITY OF ALCOHOL FOR TEMPERATURE.

Sp. Gr.	1° C.	1° F.	Sp. Gr.	1° C.	1° F.
·794–·864	·00083	·00046	·965–·966	·00047	·00026
·864–·889	81	45	·966–·967	45	25
·889–·902	79	44	·967–·968	43	24
·902–·912	77	43	·968–·969	41	23
·912–·921	76	42	·969–·970	40	22
·921–·928	74	41	·970–·971	38	21
·928–·935	72	40	·971–·973	36	20
·935–·940	70	39	·973–·974	34	19
·940–·943	68	38	·974–·975	32	18
·943–·946	67	37	·975–·976	31	17
·946–·949	65	36	·976–·977	29	16
·949–·951	63	35	·977–·978	27	15
·951–·953	61	34	·978–·980	25	14
·953–·955	59	33	·980–·981	23	13
·955–·957	58	32	·981–·983	22	12
·957–·959	56	31	·983–·985	20	11
·959–·961	54	30	·985–·987	18	10
·961–·962	52	29	·987–·990	16	·00009
·962–·963	50	28	·990–·995	14	8
·963–·965	49	27	·995–1·000	13	7

Multiply the factor in the column under 1° C. or 1° F., as the case may be, by the difference in temperature, and add the quotient to the observed gravity if the temperature of observation is above 60° F., or subtract it if it is below 60° F. The result is the specific gravity at 60° F. (15·5° C.).

Thus, the specific gravity at 60° F. of alcohol of specific gravity ·963 at 65° F. is

$$\cdot963 + (\cdot00027 \times 5) = \cdot96435.$$

EXAMPLES.

The following are given as examples of problems in connection with the blending of spirituous liquors.

(1) It is required to make 110 gallons of alcohol at 45 U.P. (= 55 per cent. proof spirit) by mixing alcohol at 60 O.P. (= 160 per cent. proof spirit) with alcohol at 48 U.P. (= 52 per cent. proof spirit). Let x = gallons of stronger spirit.

Then $(110 - x)$ = gallons of weaker spirit; and

$$(110 - x)\,52 \times 160\,x = (110)\,(55);$$

whence

$$x = 3\cdot05 \text{ gallons.}$$

(2) It is required to fortify 50 gallons of alcohol at 40 U.P. up to 15 U.P., by adding spirit at 60 O.P. Let x = gallons of strong spirit required. Then

$$(50)\,(60) + 160\,x = (50 + x)\,85;$$

whence

$$x = 16\cdot66.$$

Change of volume occurring on dilution is here neglected.

Similar calculations of course apply to admixture of other substances.

TABLE SHOWING THE BOILING POINTS OF MIXTURES OF ALCOHOL AND WATER.

Temp. of Vapour °C.	Alcohol per cent. by volume in the Boiling Liquid.	Alcohol per cent. by volume in the Distillate.	Temp. of Vapour °C.	Alcohol per cent. by volume in the Boiling Liquid.	Alcohol per cent. by volume in the Distillate.
77·2	92	93	87·5	20	71
77·5	90	92	88·7	18	68
77·8	85	91·5	90·0	15	66
78·2	80	90·5	91·2	12	61
78·7	75	90	92·5	10	55
79·4	70	89	93·7	7	50
80·0	65	87	95·0	5	42
81·2	50	85	96·2	3	36
82·5	40	82	97·5	2	18
83·7	35	80	98·7	1	13
85·0	30	78	100·0	0	—
86·2	25	76			

SECTION XI.—BEER.

"*Lbs. per barrel,*" or "brewers' pounds," is the excess of the weight of a barrel of wort over the weight of a barrel of water, the latter weighing 360 lbs.

$$\text{Lbs. per barrel} = \text{Degrees of gravity} \times 0{\cdot}36.$$

$$\text{Degrees of gravity} = \frac{\text{lbs. per barrel}}{0{\cdot}36}.$$

By "*degrees of gravity*" is meant the excess over 1000 in gravity of wort. Thus wort of S.G. 1055 = has 55 degrees of gravity. In this, as in other calculations relating to brewing, water is taken as 1000.

"*Extract per quarter*" of malt, or "solution extract," is expressed in lbs. per barrel, thus:—

$$\text{Extract per quarter} = \frac{\text{barrels of wort} \times \text{lbs. per barrel}}{\text{quarters used.}}.$$

$$\textit{Dry or Solid Extract} = \text{lbs. per barrel} \times 2{\cdot}597.$$

$$\text{Lbs. per barrel} = \frac{\text{solid extract}}{2{\cdot}597}.$$

$$\text{Per cent. of extract} = \frac{\text{solid extract per quarter} \times 100}{336}.$$

$$\frac{\text{Degrees of gravity}}{3{\cdot}85} = \text{lbs. solid extract per 10 gallons.}$$

$$\text{Degrees of gravity} \times {\cdot}26 = \quad ,, \qquad ,, \qquad ,,$$

$$\frac{\text{Degrees of gravity} \times 260}{\text{Sp. gr}} = \text{lbs. solid extract per 100 lbs. of}$$
wort.

$$\text{Degrees of gravity} \times {\cdot}935 = \text{lbs. solid extract per barrel.}$$

$$\text{Twaddle} \times 5 = \text{degrees of gravity.}$$

$$(\text{Twaddle} \times 5) + 1000 = \text{sp. gr.}$$

$$\frac{14{,}800}{148 - \text{Beaumé degrees}} = \text{sp. gr.}$$

To ascertain extract per quarter (2 cwt.) of sugar (equivalent to 1 qr. malt).

Take 1 oz. of the sugar and dissolve in water, making up to 10 fl. oz. (equal to 36 lbs. of sugar to a barrel of water) determine the degrees of gravity, and multiply by 2·24. If the multiplier 1·12 be used, the extract per 1 cwt. is obtained, and if this be multiplied by 2·597, the result expresses the solid extract per cwt., the difference between this and 112 being lbs. of water, &c., per cwt.

The following are the *Excise equivalents* for materials.

1 qr. of malt or corn . . . = 336 lbs. =
„ Rice, flaked maize, &c. = 256 „ =
„ Cane sugar . . . . = 224 „ =
„ Saccharum or glucose. = 256 „ =
„ Syrup No. 1 . . . = 272 „ =
„ Syrup No. 2 . . . = 328 „ =
144 galls. wort at 55 (sp. gr. 1055).

$$\frac{\text{Lbs. No. 1 syrup} \times 14}{17} = \text{cane sugar equiv.}$$

$$\frac{\text{Lbs. No. 2 syrup} \times 28}{41} = \text{cane sugar equiv.}$$

$$\frac{\text{Lbs. saccharum or glucose} \times 7}{8} = \text{cane sugar equiv.}$$

Standard wort of the Excise has a gravity of 1055, or degrees of gravity 55, and wort of any other gravity is expressed in terms of this for the purpose of assessing the beer duty of 6*s*. 9*d*. per gallon.

$$\text{Standard gallons of 55} = \frac{\text{bulk galls.} \times \text{degree of grav.}}{55},$$

or in general

$$\left.\begin{array}{l}\text{galls. (of wort A)} \\ \text{at degree of grav. A}\end{array}\right\} = \frac{\text{bulk galls. (of B)} \times \text{degree of grav. B}}{\text{degree of grav. A}}.$$

If it is required to obtain a wort of any intermediate gravity by admixture of a stronger and weaker wort,

$$\frac{\text{galls. of strong}}{\text{galls. of weak}} = \frac{\text{interm. grav.} - \text{weaker grav.}}{\text{stronger grav.} - \text{interm. grav.}}.$$

For sp. gr. of wort, see under Sugar, pp. 507, 515–517.

Original Gravity of Beer by Distillation Method. Distil a convenient vol. (e.g. 100 cm.^{3} measured at 60°. F.), make up both residue and distillate to the original vol. (100 cm.^{3}) and determine the sp. gr. of each. The difference between the sp. gr. of water (1000) and the sp. gr. of the spirituous distillate is called the "spirit indication," and the relation of this to the "gravity lost" during fermentation is given in the table, p. 503. The table includes the usual acidity of fresh beer, ·1 per cent. acetic acid = 1·4 spiritised—but if there is an undue amount of acidity (a) in the beer this must be determined and allowed for by the formula $1·3\,a - ·14$ = spiritised.

The spirit indication thus corrected is converted into "gravity lost" by the table, and this, added to the observed gravity of the residue of the beer (the extract) as determined above, gives the original gravity. The acidity may be determined by titration with a standard ammonia of sp. gr. ·9986 at 60° F., of which cm.^{3} = 1 gram acetic acid.

Instead of the distillation method, or as a check, the original gravity may be obtained by subtracting the sp. gr. of the original beer from that of the extract to obtain "spirit indication." The allowance must be made for acid, if necessary, and the gravity lost obtained from the table given for the *evaporation method* (p. 504).

TABLE BY GRAHAM, HOFFMAN, AND REDWOOD, SHOWING THE STRENGTH OF WORT CORRESPONDING TO SPIRIT INDICATION (FOR THE DISTILLATION PROCESS).

Degrees of Spirit Indication.	·0	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	0·0	0·3	0·6	0·9	1·2	1·5	1·8	2·1	2·4	2·7
1	3·0	3·3	3·7	4·1	4·4	4·8	5·1	5·5	5·9	6·2
2	6·6	7·0	7·4	7·8	8·2	8·6	9·0	9·4	9·8	10·2
3	10·7	11·1	11·5	12·0	12·4	12·9	13·3	13·8	14·2	14·7
4	15·1	15·5	16·0	16·4	16·8	17·3	17·7	18·2	18·6	19·1
5	19·5	19·9	20·4	20·9	21·3	21·8	22·2	22·7	23·1	23·6
6	24·1	24·6	25·0	25·5	26·0	26·4	26·9	27·4	27·8	28·3
7	28·8	29·2	29·7	30·2	30·7	31·2	31·7	32·2	32·7	33·2
8	33·7	34·3	34·8	35·4	35·9	36·5	37·0	37·5	38·0	38·6
9	39·1	39·7	40·2	40·7	41·2	41·7	42·2	42·7	43·2	43·7
10	44·2	44·7	45·1	45·6	46·0	46·5	47·0	47·5	48·0	48·5
11	49·0	49·6	50·1	50·6	51·2	51·7	52·2	52·7	53·3	53·8
12	54·3	54·9	55·4	55·9	56·4	56·9	57·4	57·9	58·4	59·9
13	59·4	60·0	60·5	61·1	61·6	62·2	62·7	63·3	63·8	64·3
14	64·8	65·4	65·9	66·5	67·1	67·6	68·2	68·7	69·3	69·9
15	70·5	71·1	71·7	72·3	72·9	73·5	74·1	74·7	75·3	75·9

TABLE BY GRAHAM, HOFFMAN, AND REDWOOD, SHOWING THE STRENGTH OF WORT CORRESPONDING TO SPIRIT INDICATION (FOR THE EVAPORATION PROCESS).

Degrees of Spirit Indication.	0	·1	·2	·3	·4	·5	·6	·7	·8	·9
0	..	·3	·7	1·0	1·4	1·7	2·1	2·4	2·8	3·1
1	3·5	3·8	4·2	4·6	5·0	5·4	5·8	6·2	6·6	7·0
2	7·4	7·8	8·2	8·7	9·1	9·5	9·9	10·3	10·7	11·1
3	11·5	11·9	12·4	12·8	13·2	13·6	14·0	14·4	14·8	15·3
4	15·8	16·2	16·6	17·0	17·4	17·9	18·4	18·8	19·3	19·8
5	20·3	20·7	21·2	21·6	22·1	22·5	23·0	23·4	23·9	24·3
6	24·8	25·2	25·6	26·1	26·6	27·0	27·5	28·0	28·5	29·0
7	29·5	30·0	30·4	30·9	31·3	31·8	32·3	32·8	33·3	33·8
8	34·3	34·9	35·5	36·0	36·6	37·1	37·7	38·3	38·8	39·4
9	40·0	40·5	41·0	41·5	42·0	42·5	43·0	43·5	44·0	44·4
10	44·9	45·4	46·0	46·5	47·1	47·6	48·2	48·7	49·3	49·8
11	50·3	50·9	51·4	51·9	52·5	53·0	53·5	54·0	54·5	55·0
12	55·6	56·2	56·7	57·3	57·8	58·3	58·9	59·4	59·9	60·5
13	61·0	61·6	62·1	62·7	63·2	63·8	64·3	64·9	65·4	66·0
14	66·5	67·0	67·6	68·1	68·7	69·2	69·8	70·4	70·9	71·4
15	72·0									

ACIDITY OF BEER, CONSIDERED AS ACETIC ACID, WITH CORRESPONDING DEGREES OF SPIRIT INDICATION.

Excess per cent. of Acid.	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09
0	..	·02	·04	·06	·07	·08	·09	·11	·12	·13
·1	·14	·15	·17	·18	·19	·21	·22	·23	·24	·26
·2	·27	·28	·29	·31	·32	·33	·34	·35	·37	·38
·3	·39	·40	·42	·43	·44	·46	·47	·48	·49	·51
·4	·52	·53	·55	·56	·57	·59	·60	·61	·62	·64
·5	·65	·66	·67	·69	·70	·71	·72	·73	·75	·76
·6	·77	·78	·80	·81	·82	·84	·85	·86	·87	·89
·7	·90	·91	·93	·94	·95	·97	·98	·99	1·10	1·02
·8	1·03	1·04	1·05	1·07	1·08	1·09	1·10	1·11	1·13	1·14
·9	1·15	1·16	1·18	1·19	1·21	1·22	1·23	1·25	1·26	1·28
1·0	1·29	1·31	1·33	1·35	1·36	1·37	1·38	1·40	1·41	1·42

TABLE FOR SALT IN BEER.

22 cm.³ beer employed and the salt estimated by titration with $\frac{N}{10}$ $AgNO_3$.

Cm.³ $\frac{N}{10}$ $AgNO_3$.	NaCl, grams per gall.	Cm.³ $\frac{N}{10}$ $AgNO_3$.	NaCl, grams per gall.	Cm.³ $\frac{N}{10}$ $AgNO_3$.	NaCl, grams per gall.
·1	1·64	2·2	36·04	4·3	70·43
·2	3·28	2·3	37·67	4·4	72·07
·3	4·91	2·4	39·31	4·5	73·71
·4	6·55	2·5	40·95	4 6	75·35
·5	8·19	2·6	42·59	4·7	76·99
·6	9·83	2·7	44·23	4·8	78·62
·7	11·47	2·8	45·86	4·9	80·26
·8	13·10	2·9	47·50	5·0	81·90
·9	14·74	3·0	49·14	5·1	83·54
1·0	16·38	3·1	50·78	5·2	85·18
1·1	18·02	3·2	52·42	5·3	86·81
1·2	19·66	3·3	54·04	5·4	88·45
1·3	21·29	3·4	55·69	5·5	90 09
1·4	22·93	3·5	57·33	5·6	91·73
1·5	24·57	3·6	58·97	5·7	93·37
1·6	26·21	3·7	60·61	5·8	95·00
1·7	27·85	3·8	62·24	5·9	96·64
1·8	29·48	3·9	63·88	6·0	98·28
1·9	31·12	4·0	65·52	6·1	99·92
2·0	32·76	4·1	67·16	6·2	101·56
2·1	34·40	4·2	68·80	6·3	103·20

TABLES USED IN THE ANALYSIS OF BEER, &C.

Table A.—Specific Gravity and Strength of Spirits.

Volume per cent.	Weight per cent.	Specific Gravity.	Volume per cent.	Weight per cent.	Specific Gravity.
1·0	0·80	0·99850	4·6	3·68	0·99336
1·1	0·88	0·99835	4·7	3·76	0·99322
1·2	0·96	0·99820	4·8	3·84	0·99308
1·3	1·04	0·99805	4·9	3·92	0·99294
1·4	1·12	0·99790	5·0	4·00	0·99280
1·5	1·20	0·99775	5·1	4·08	0·99267
1·6	1·28	0·99760	5·2	4·16	0·99254
1·7	1·36	0·99745	5·3	4·24	0·99241
1·8	1·44	0·99730	5·4	4·32	0·99228
1·9	1·52	0·99715	5·5	4·40	0·99215
2·0	1·60	0·99700	5·6	4·48	0·99202
2·1	1·68	0·99686	5·7	4·56	0·99189
2·2	1·76	0·99672	5·8	4·64	0·99176
2·3	1·84	0·99658	5·9	4·72	0·99163
2·4	1·92	0·99644	6·0	4·81	0·99150
2·5	2·00	0·99630	6·1	4·89	0·99137
2·6	2·08	0·99616	6·2	4·97	0·99124
2·7	2·16	0·99602	6·3	5·05	0·99111
2·8	2·24	0·99588	6·4	5·13	0·99098
2·9	2·32	0·99574	6·5	5·21	0·99085
3·0	2·40	0·99560	6·6	5·30	0·99072
3·1	2·48	0·99546	6·7	5·38	0·99059
3·2	2·56	0·99532	6·8	5·46	0·99046
3·3	2·64	0·99518	6·9	5·54	0·99033
3·4	2·72	0·99504	7·0	5·62	0·99020
3·5	2·80	0·99490	7·1	5·70	0·99008
3·6	2·88	0·99476	7·2	5·78	0·98996
3·7	2·96	0·99462	7·3	5·86	0·98984
3·8	3·04	0·99448	7·4	5·94	0·98972
3·9	3·12	0·99434	7·5	6·02	0·98960
4·0	3·20	0·99420	7·6	6·11	0·98949
4·1	3·28	0·99406	7·7	6·19	0·98936
4·2	3·36	0·99392	7·8	6·27	0·98924
4·3	3·44	0·99378	7·9	6·35	0·98912
4·4	3·52	0·99364	8·0	6·43	0·98900
4·5	3·60	0·99350			

TABLES USED IN THE ANALYSIS OF BEER, &c.—*continued.*

Table B.—Specific Gravity and Strength of Malt Extract.

Specific Gravity.	Malt Extract in 100 parts of Liquid.	Specific Gravity.	Malt Extract in 100 parts of Liquid.	Specific Gravity.	Malt Extract in 100 parts of Liquid.
1·000	0·000	1·024	6·000	1·048	11·809
1·001	0·250	1·025	6·244	1·049	12·047
1·002	0·500	1·026	6·488	1·050	12·285
1·003	0·750	1·027	6·731	1·051	12·523
1·004	1·000	1·028	6·975	1·052	12·761
1·005	1·250	1·029	7·219	1·053	13·000
1·006	1·500	1·030	7·463	1·054	13·238
1·007	1·750	1·031	7·706	1·055	13·476
1·008	2·000	1·032	7·950	1·056	13·714
1·009	2·250	1·033	8·195	1·057	13·952
1·010	2·500	1·034	8·438	1·058	14·190
1·011	2·750	1·035	8·681	1·059	14·428
1·012	3·000	1·036	8·925	1·060	14·666
1·013	3·250	1·037	9·170	1·061	14·904
1·014	3·500	1·038	9·413	1·062	15·139
1·015	3·750	1·039	9·657	1·063	15·371
1·016	4·000	1·040	9·901	1·064	15·604
1·017	4·250	1·041	10·142	1·065	15·837
1·018	4·500	1·042	10·381	1·066	16·070
1·019	4·750	1·043	10·619	1·067	16·302
1·020	5·000	1·044	10·857	1·068	16·534
1·021	5·250	1·045	11·095	1·069	16·767
1·022	5·500	1·046	11·333	1·070	17·000
1·023	5·750	1·047	11·595		

SECTION XII.—SUGAR.

Saccharometry.

The specific rotatory power of a sugar is determined by observing its influence upon polarised light.

$$\text{Specific rotatory power} = \frac{100\,a}{l \times c},$$

where a = angular rotation, l = length of the tube in decimetres, c = grams of substance in 100 cm.^{3} of liquid.

The rotation produced by quartz of 1 millimetre thickness for the D line is 21° 40′, and the weights of cane sugar per 100 cm.^{3} producing the same rotation in a 2-decimetre tube is 16·350 grams, hence cane sugar has a specific rotatory power for the D line of 66·50° (= S_D) for concentrations of 16 to 17 per cent. For other concentrations, $S_D = 68{\cdot}65 - {\cdot}828\,c + {\cdot}115415\,c^2 - {\cdot}00541666\,c^3$. Specific rotatory power of cane sugar for the transition test = $S_j = 73{\cdot}8°$.

$$\frac{S_j}{S_D} = \frac{73{\cdot}8}{66{\cdot}5} = 1{\cdot}110. \qquad \frac{S_D}{S_j} = \frac{66{\cdot}5}{73{\cdot}8} = {\cdot}9011.$$

Cane Sugar.—*Estimation by the polarimeter.* The instruments, graduated in per cents., require from 16·19 grams to 16·35 grams per 100 cm.^{3} (for Soleil's instrument) varying with the maker of the instrument.

Both sodium flame and transition tint instruments require the same concentration, but in the former the rotation corresponding to 100 per cent. is 21·73°, and in the latter 24°. The Ventzke-Soleil instrument requires 26·048 grams. For determining per cent. from the angular degrees, dissolve 18·80 grams to 100 cm.^{3}, observe in 2-decimetre tube, and multiply degrees of observed rotation by 4; use basic acetate of lead to decolorise the solution.

By Inversion.—After observing direct rotation, invert and measure the lævo-rotation at observed temperature.

$$c = \frac{100\ \mathrm{D}}{144 - \frac{t}{2}},$$

c being the + angular rotation due to cane sugar, D the change due to inversion (i.e. original dextro-degrees added to the lævo-degrees, thus + 30 added to − 7 = 37) and t the temperature °C.

SPECIFIC ROTATORY POWERS FOR 10 PER CENT. SOLUTIONS OF VARIOUS SUGARS.

Varieties of Sugar.	Formula.	Specific Rotatory Power.		Observer.
		S_D	S_j	
Cane sugar .	$C_{12}H_{22}O_{11}$	+ 66·5	+ 73·8	Hesse. Tollens. Berthelot.
Milk sugar .	$C_{12}H_{22}O_{11} + H_2O$	α + 80 β + 52·7 β + 53·1	+ 88·8 + 58·5 + 58·9	Hesse. Hesse. Mills and Hogarth.
Maltose . .	$C_{12}H_{22}O_{11}$	+ 139·2	+ 154·5	O'Sullivan. Steiner. Meissl.
Sucro-dextrose	$C_6H_{12}O_6$	α + 91 to 100 β + 51·9	+ 101–112 + 57·6	Various. Average.
Lævulose . .	$C_6H_{12}O_6$	−98·0 at 15° C. −51·9 at 88° C.	− 108 at 15° C. − 57·6 at 15° C.	Deduced.
Invert sugar .	$2C_6H_{12}O_6$	−20·05 at 15° C. −0° at 88° C.	−25·6 at 15° C. −0 at 88° C.	Cassamajor. Tuschmidt.

USE OF LAURENT'S POLARIMETER (SACCHARIMETER).

Weigh 16·2 grams of the sugar, dissolve to 100 cm.^{3}, and add 10 cm.^{3} of basic acetate of lead if necessary.

The 20-centimetre tube is used, or the 22-centimetre tube if the basic acetate has been added. The percentage of saccharose is given by the degrees of the instrument, the quantity of sugar per litre by the following table :—

Divisions.	Sugar per Litre.
1	1·62 grams.
2	3·24 "
3	4·86 "
4	6·48 "
5	8·10 "
6	9·72 grams.
7	11·34 "
8	12·96 "
9	14·55 "

If it is necessary to invert, A being the sum or difference of the observed degrees, and T the temperature °C.

$$P \text{ (rotative power)} = \frac{200 \times A}{288 - T}; \quad P \times 1{\cdot}62 = \text{sugar per litre.}$$

Basic Acetate of Lead.—Dissolve 50 grams of lead acetate in 900 cm.^{3} of water, and digest for 10 hours with 50 grams litharge.

Boussingault's Solution (for Sugar).—Dissolve 40 grams copper sulphate (crys.) in 200 cm.^{3} of water. Take 160 grams of neutral potassium tartrate and 180 grams of fused sodium hydrate, and dissolve in 600 cm.^{3} of water. Mix the two solutions, dilute to 1 litre, and boil for some minutes. This solution is unalterable. The ingredients must be pure.

Fehling's Solution. — (1) 34·64 grams $CuSO_4$, 5 aq to 500 cm.^{3}; (2) NaHO (containing 97 p.c. or more), Rochelle salt ($KNa\overline{T}$), 180 grams to 500 cm.^{3}; mix (1) and (2) in equal volumes when required for use. For *gravimetric* determination, dilute 25 cm.^{3} with 50 cm.^{3} water, and heat with a known quantity (insufficient to remove all blueness) of solution of reducing sugar in water-bath for 15 minutes. Filter off precipitate, wash, ignite, and weigh CuO (*v.* p. 518). For *volumetric* determination, mix 10 cm.^{3} with 30 cm.^{3} water, boil, add sugar solution, containing ·5 to 1·0 gram per 100 cm.^{3}, a little (c. 2 cm.^{3}) at a time, until last few drops discharge colour from supernatant liquid. The volume of sugar solution required contains ·05 grams glucose, ·0475 (inverted) cane sugar, ·0678 lactose.

(*Proceed to page* 514.)

TABLE FOR THE DETERMINATION OF THE VALUE IN SUGAR OF BEETROOT JUICE AND OTHER LIQUIDS BY MEANS OF THE POLARIMETER OF FRÈZE OR THE APPARATUS OF LAURENT.

Observed Degrees, 20-cm.³ Tube.	Corrected Degrees for 22-cm.³ Tube.	Grams of Sugar per 100 cm.³ of Solution.	Specific Gravity of Solution.	Grams of Sugar per 100 grams of Liquid.	Observed Degrees, 20-cm.³ Tube.	Corrected Degrees for 22-cm.³ Tube.	Grams of Sugar per 100 cm.³ of Solution.	Specific Gravity of Solution.	Grams of Sugar per 100 grams of Liquid.
8	8·8	6·6	1·0255	6·44	16	17·60	13·20	1·0509	12·56
8·25	9·07	6·8	·0263	6·63	16·25	17·87	13·40	·0517	12·74
8·50	9·35	7·01	·0271	6·83	16·50	18·15	13·61	·0524	12·93
8·75	9·62	7·22	·0279	7·02	16·75	18·42	13·82	·0533	13·12
9	9·90	7·43	·0387	7·22	17	18·70	14·03	·0541	13·31
9·25	10·17	7·63	·0295	7·41	17·25	18·97	14·23	·0548	13·49
9·50	10·45	7·84	·0303	7·61	17·50	19·25	14·44	·0556	13·68
9·75	10·72	8·04	·0311	7·80	17·75	19·52	14·64	·0564	13·86
10	11·00	8·25	·0319	7·99	18	19·80	14·85	·0572	10·04
10·25	11·27	8·45	·0326	8·18	18·25	20·07	15·05	·0580	14·23
10·50	11·55	8·66	·0335	8·38	18·50	20·35	15·26	·0588	14·41
10·75	11·82	8·87	·0343	8·58	18·75	20·62	15·47	·0596	14·60
11	12·10	9·08	·0351	8·77	19	20·90	15·68	·0604	14·79
11·25	12·37	9·28	·0358	8·96	19·25	21·17	15·88	·0611	14·97
11·50	12·65	9·49	·0366	9·15	19·50	21·45	16·09	·0619	15·15
11·75	12·92	9·69	·0374	9·34	19·75	21·72	16·29	·0627	15·33
12	13·20	9·90	·0382	9·54	20	22·00	16·50	·0635	15·51
12·25	13·47	10·10	·0390	9·72	20·25	22·27	16·70	·0643	15·69
12·50	13·75	10·31	·0398	9·92	20·50	22·55	16·91	·0651	15·88
12·75	14·02	10·52	·0406	10·11	20·75	22·82	17·12	·0660	16·06
13	14·30	10·73	·0414	10·30	21	23·10	17·33	·0667	16·24
13·25	14·57	10·93	·0422	10·49	21·25	23·37	17·53	·0674	16·42
13·50	14·85	11·14	·0431	10·68	21·50	23·65	17·74	·0682	16·61
13·75	15·12	11·34	·0438	10·86	21·75	23·92	17·94	·0690	16·78
14	15·40	11·55	·0445	11·06	22	24·20	18·15	·0698	16·97
14·25	15·67	11·75	·0453	11·24	22·25	24·47	18·35	·0706	17·14
14·50	15·95	11·96	·0461	11·43	22·50	24·75	18·56	·0714	17·32
14·75	16·22	12·17	·0469	11·62	22·75	25·02	18·77	·0722	17·51
15	16·50	12·38	·0477	11·82	23	25·30	18·98	·0729	17·69
15·25	16·77	12·58	·0485	11·99	23·25	25·57	19·18	·0738	17·86
15·50	17·05	12·79	·0493	12·19	23·50	25·85	19·39	·0746	18·04
15·75	17·32	12·99	·0501	12·37	23·75	26·12	19·59	1·0753	18·22

CLERGET'S TABLE FOR CORRECTING THE INDICATIONS OF SOLEIL'S SACCHARIMETER IN THE ESTIMATION OF SUGAR.

10° C.	15° C.	20° C.	N.	N′.	10° C.	15° C.	20° C.	N.	N′.
1·39	1·37	1·34	1	1·64	58·42	57·36	56·30	42	68·67
2·78	2·73	2·68	2	3·27	59·81	58·73	57·64	43	70·31
4·16	4·10	4·02	3	4·91	61·20	60·09	58·98	44	71·95
5·56	5·46	5·36	4	6·54	62·59	61·46	60·32	45	73·58
6·95	6·83	6·70	5	8·17	63·99	62·82	61·66	46	75·22
8·35	8·19	8·04	6	9·81	65·38	64·19	63·00	47	76·85
9·74	9·56	9·38	7	11·44	66·77	65·56	64·34	48	78·48
11·13	10·93	10·72	8	13·08	68·17	66·92	65·68	49	80·12
12·52	12·29	12·06	9	14·71	69·57	68·29	67·03	50	81·75
13·91	13·66	13·41	10	16·35	70·95	69·66	68·37	51	83·38
15·30	15·03	14·75	11	17·99	72·34	71·02	69·71	52	85·01
16·69	16·40	16·09	12	19·62	73·73	72·39	71·05	53	86·65
18·08	17·77	17·43	13	21·26	75·12	73·76	72·40	54	88·29
19·47	19·14	18·77	14	22·89	76·51	75·12	73·74	55	89·93
20·86	20·51	20·11	15	24·52	77·90	76·49	75·08	56	91·56
22·26	21·88	21·45	16	26·16	79·29	77·85	76·42	57	93·20
23·65	23·25	22·79	17	27·79	80·68	79·22	77·76	58	94·83
25·04	24·62	24·13	18	29·43	82·07	80·59	79·10	59	96·46
26·43	25·90	25·47	19	31·06	83·46	81·94	80·43	60	98·10
27·82	27·31	26·81	20	32·70	84·86	83·31	81·78	61	99·73
29·21	28·68	28·15	21	34·34	86·25	84·68	83·12	62	101·4
30·60	30·05	29·49	22	35·98	87·64	86·05	84·46	63	103·0
31·99	31·42	30·83	23	37·61	89·02	87·43	85·80	64	104·6
33·38	32·79	32·16	24	39·25	90·41	88·80	87·14	65	106·3
34·77	34·16	33·51	25	40·88	91·81	90·16	88·48	66	107·9
36·17	35·53	34·85	26	42·51	93·20	91·54	89·82	67	109·5
37·57	36·90	36·19	27	44·15	94·59	92·90	91·16	68	111·2
38·94	38·25	37·53	28	45·78	96·00	94·25	92·50	69	112·8
40·34	39·60	38·87	29	47·42	97·38	95·60	93·83	70	114·4
41·74	40·97	40·21	30	49·05	98·77	96·96	95·17	71	116·1
43·12	42·33	41·55	31	50·69	100·2	98·33	96·51	72	117·7
44·51	43·70	42·89	32	52·33	101·6	99·70	97·85	73	119·3
45·90	45·07	44·23	33	53·97	102·9	101·1	99·19	74	121·0
47·20	46·43	45·57	34	55·60	104·3	102·4	100·5	75	122·6
48·68	47·80	46·91	35	57·24	105·7	103·8	101·9	76	124·2
50·08	49·16	48·25	36	58·87	107·1	105·2	103·2	77	125·9
51·47	50·53	49·59	37	60·50	108·5	106·5	104·5	78	127·5
52·86	51·90	50·93	38	62·14	109·9	107·9	105·9	79	129·1
54·25	53·26	52·27	39	63·77	111·3	109·3	107·2	80	130·8
55·64	54·63	53·63	40	65·40	112·7	110·9	108·6	81	132·4
57·03	55·99	54·96	41	67·03	114·1	112·0	109·9	82	134·1

CLERGET'S TABLE FOR CORRECTING, &c.—*continued.*

10° C.	15° C.	20° C.	N.	N′.	10° C.	15° C.	20° C.	N.	N′.
115·5	113·3	111·3	83	135·7	148·8	146·1	143·4	107	174·9
116·9	114·7	112·6	84	137·3	150·2	147·5	144·8	108	176·6
118·2	116·1	113·9	85	139·0	151·6	148·8	146·1	109	178·2
119·6	117·4	115·3	86	140·6	153·0	150·2	147·4	110	179·8
121·0	118·8	116·6	87	142·2	154·4	151·6	148·8	111	181·5
122·4	120·2	118·0	88	143·9	155·8	153·0	150·1	112	183·1
123·8	121·5	119·3	89	145·5	157·2	154·4	151·5	113	184·7
125·2	122·9	120·6	90	147·1	158·6	155·7	152·8	114	186·4
126·6	124·3	122·0	91	148·7	160·0	157·0	154·2	115	188·0
128·0	125·6	123·3	92	150·4	161·3	158·4	155·4	116	189·7
129·4	127·0	124·7	93	152·1	162·7	159·8	156·8	117	191·3
130·8	128·4	126·0	94	153·7	164·1	161·2	158·2	118	192·9
132·2	129·7	127·4	95	155·3	165·5	162·5	159·5	119	194·6
133·6	131·1	128·7	96	156·9	166·0	163·9	160·8	120	196·2
134·9	132·5	130·0	97	158·6	168·3	165·3	162·2	121	197·8
136·3	133·8	131·4	98	160·2	169·7	166·6	163·5	122	199·5
137·7	135·2	132·7	99	161·9	171·1	168·0	164·9	123	201·1
139·1	136·6	134·0	100	163·5	172·5	169·4	166·2	124	202·7
140·5	137·9	135·4	101	165·1	173·9	170·7	167·6	125	204·4
141·9	139·3	136·7	102	166·8	175·3	172·1	168·9	126	206·0
143·3	140·7	138·1	103	168·4	176·6	173·5	170·2	127	207·6
144·7	142·0	139·4	104	170·0	178·0	174·8	171·6	128	209·3
146·0	143·4	140·8	105	171·7	179·4	176·2	172·9	129	210·9
147·4	144·8	142·1	106	173·3	180·8	177·5	174·2	130	212·6

Use of this Table.

Number observed upon the Scale before immersion = D.
" " after " = D′.
Temperature C. .. .. = T.

1. The two figures indicated upon the scale are read to right and left of zero, the sum D + D = A.

In the column of temperature nearest to that at the time of observation we find the figure approaching nearest to A, following the line horizontally we find under N and N′ figures indicating the quantity of sugar.

The sugar employed contains N per cent. of crystallized sugar or N′ grams per litre.

The sugar solution being prepared as before, we read D and D′ to the same side of zero, and take D − D′ = A, and proceed as before.

The following approximate formula can be used instead of the Table—

$$P \text{ (rotative power)} = \frac{200 \times A}{288 - T}\,;\ P \times 1{\cdot}635 = \text{sugar in 1 litre.}$$

Gerrard's Cyano-cupric Solution (Gerrard, Allen).—Take 10 cm.^{3} Fehling's solution and 40 cm.^{3} water, mix, *exactly* decolorise with 5 per cent. solution of KCN, add 10 cm.^{3} Fehling, mix, and proceed as with Fehling's solution. There is decolorisation without formation of precipitate, and the glucose = ·05 gram, only the 10 cm.^{3} last added being concerned in the reaction.

Knapp's Standard Mercuric Cyanide Solution.—Dissolve 10 grams $Hg(CN)_2$ in 600 cm.^{3} water, add 100 cm.^{3} caustic soda solution (sp. gr. 1·145), dilute to 1 litre. Standardise with a solution of glucose containing ·5 gram per 100 cm.^{3}

Sacchse's Standard Mercuric Iodide Solution.—Dissolve 18 grams HgI_2 and 25 grams KI in water, add a solution containing 80 grams caustic potash, dilute to 1 litre. Standardise with a solution of glucose containing ·5 gram per 100 cm.^{3}

Specific Gravity of Sugar Solutions.—A solution of cane sugar containing 10 per cent. by weight (= 4·21 per cent. C.) has a sp. gr. of 1·0406 at 15·5° C. (= 60° F.), and solutions of other saccharine and allied bodies, i.e. invert sugar, maltose, dextrin, starch, &c., have approximately the same density. This is equal to a sp. gr. of 1·0386 for a solution containing 10 grams per 100 cm.^{3} Hence, taking the sp. gr. of water as 1000,

$$\text{grams per 100 cm.}^3 = \frac{(\text{sp. gr. at } 15^\circ\text{ C.}) - 1000}{3\cdot85} = \text{W},$$

$$\text{per cent. by weight} = \frac{\text{W} \times 100}{\text{sp. gr. at } 15^\circ\text{ C. } (= 60^\circ\text{ F.})}.$$

This rule is true for concentrations up to 20 per cent., but for malt extract of greater concentration than 12 grams per 1000 cm.^{3}, the denominator 3·86 should be used.

When the sp. gr. of the solution of sugar is observed at a higher temperature than 60° F., as is often the case with worts, the rule for correction to 60° F. is

$$\text{Sp. gr. at } 60^\circ\text{ F.} = \left(1 + \frac{4\,e}{1000} + \frac{f}{100}\right)\frac{f}{10} + g,$$

where e is the excess of sp. gr. over 1000 at the temperature of observation, f is the excess of temperature above 60° F, and g is the observed gravity.

The following table shows the sp. gr. of sugar solutions at 17·5° C. (Gerlach, Balling, &c.).

Per cent.	Specific Gravity.	Per cent.	Specific Gravity.	Per cent.	Specific Gravity.
1	1·0040	28	1·1200	55	1·2609
2	1·0080	29	1·1248	56	1·2666
3	1·0120	30	1·1296	57	1·2724
4	1·0160	31	1·1344	58	1·2782
5	1·0200	32	1·1393	59	1·2840
6	1·0240	33	1·1442	60	1·2899
7	1·0281	34	1·1491	61	1·2959
8	1·0322	35	1·1540	62	1·3019
9	1·0363	36	1·1590	63	1·3079
10	1·0401	37	1·1641	64	1·3139
11	1·0443	38	1·1691	65	1·3200
12	1·0485	39	1·1742	66	1·3262
13	1·0527	40	1·1794	67	1·3324
14	1·0570	41	1·1845	68	1·3386
15	1·0613	42	1·1897	69	1·3449
16	1·0656	43	1·1950	70	1·3512
17	1·0700	44	1·2003	71	1·3575
18	1·0744	45	1·2056	72	1·3639
19	1·0788	46	1·2109	73	1·3703
20	1·0832	47	1·2163	74	1·3768
21	1·0877	48	1·2218	75	1·3833
22	1·0922	49	1·2272	80	1·4159
23	1·0968	50	1·2327	85	1·4499
24	1·1014	51	1·2383	90	1·4849
25	1·1060	52	1·2439	95	1·5209
26	1·1106	53	1·2495	99	1·5504
27	1·1153	54	1·2552		

Table by Dr. Ure, showing the Quantity of Sugar in Pounds Avoirdupois contained at successive Degrees of Specific Gravity, at 60° Fahr. (15·5° C.).

Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.
1·000	0·0000	1·037	0·9449	1·074	1·9385	1·111	2·9263
1·001	0·0255	1·038	0·9768	1·075	1·9653	1·112	2·9522
1·002	0·0510	1·039	1·0090	1·076	1·9928	1·113	2·9780
1·003	0·0765	1·040	1·0400	1·077	2·1097	1·114	3·0045
1·004	0·1020	1·041	1·0653	1·078	2·0465	1·115	3·0304
1·005	0·1275	1·042	1·0906	1·079	2·0734	1·116	3·0563
1·006	0·1530	1·043	1·1159	1·080	2·1006	1·117	3·0821
1·007	0·1785	1·044	1·1412	1·081	2·1275	1·118	3·1080
1·008	0·2040	1·045	1·1665	1·082	2·1543	1·119	3·1343
1·009	0·2295	1·046	1·1918	1·083	2·1811	1·120	3·1610
1·010	0·2550	1·047	1·2171	1·084	2·2080	1·121	3·1871
1·011	0·2805	1·048	1·2424	1·085	2·2359	1·122	3·2130
1·012	0·3060	1·049	1·2687	1·086	2·2627	1·123	3·2399
1·013	0·3315	1·050	1·2940	1·087	2·2894	1·124	3·2658
1·014	0·3570	1·051	1·3206	1·088	2·3161	1·125	3·2916
1·015	0·3825	1·052	1·3472	1·089	2·3438	1·126	3·3174
1·016	0·4180	1·053	1·3738	1·090	2·3710	1·127	3·3431
1·017	0·4335	1·054	1·4004	1·091	2·3987	1·128	3·3690
1·018	0·4590	1·055	1·4270	1·092	2·4256	1·129	3·3949
1·019	0·4845	1·056	1·4536	1·093	2·4524	1·130	3·4211
1·020	0·5100	1·057	1·4802	1·094	2·4792	1·131	3·4490
1·021	0·5351	1·058	1·5068	1·095	2·5061	1·132	3·4769
1·022	0·5602	1·059	1·5334	1·096	2·5329	1·133	3·5048
1·023	0·5853	1·060	1·5600	1·097	2·5598	1·134	3·5326
1·024	0·6104	1·061	1·5870	1·098	2·5866	1·135	3·5605
1·025	0·6355	1·062	1·6142	1·099	2·6130	1·136	3·5882
1·026	0·6606	1·063	1·6414	1·100	2·6404	1·137	3·6160
1·027	0·6857	1·064	1·6688	1·101	2·6663	1·138	3·6437
1·028	0·7108	1·065	1·6959	1·102	2·6921	1·139	3·6716
1·029	0·7359	1·066	1·7228	1·103	2·7188	1·140	3·7000
1·030	0·7610	1·067	1·7496	1·104	2·7446	1·141	3·7281
1·031	0·7861	1·068	1·7764	1·105	2·7704	1·142	3·7562
1·032	0·8112	1·069	1·8033	1·106	2·7961	1·143	3·7840
1·033	0·8363	1·070	1·8300	1·107	2·8227	1·144	3·8118
1·034	0·8614	1·071	1·8571	1·108	2·8485	1·145	3·8398
1·035	0·8866	1·072	1·8843	1·109	2·8740	1·146	3·8677
1·036	0·9149	1·073	1·9116	1·110	2·9001	1·147	3·8955

TABLE BY DR. URE, SHOWING THE QUANTITY OF SUGAR IN POUNDS AVOIRDUPOIS, &c.—*continued.*

Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.	Spec. Grav.	Lbs. per Gallon.
1·148	3·9235	1·187	4·9552	1·225	5·9801	1·263	7·0133
1·149	3·9516	1·188	4·9803	1·226	6·0081	1·264	7·0444
1·150	3·9801	1·189	5·0054	1·227	6·0361	1·265	7·0751
1·151	4·0070	1·190	5·0304	1·228	6·0642	1·266	7·1060
1·152	4·0342	1·191	5·0563	1·229	6·0925	1·267	7·1369
1·153	4·0611	1·192	5·0822	1·230	6·1205	1·268	7·1678
1·154	4·0880	1·193	5·1080	1·231	6·1474	1·269	7·1988
1·155	4·1148	1·194	5·1341	1·232	6·1743	1·270	7·2300
1·156	4·1319	1·195	5·1602	1·233	6·2012	1·271	7·2601
1·157	4·1588	1·196	5·1863	1·234	6·2280	1·272	7·2902
1·158	4·1857	1·197	5·2124	1·235	6·2551	1·273	7·3204
1·159	4·2128	1·198	5·2381	1·236	6·2822	1·274	7·3506
1·160	4·2502	1·199	5·2639	1·237	6·3093	1·275	7·3807
1·161	4·2771	1·200	5·2901	1·238	6·3362	1·276	7·4109
1·162	4·3040	1·201	5·3160	1·239	6·3631	1·277	7·4409
1·163	4·3309	1·202	5·3422	1·240	6·3903	1·278	7·4708
1·164	4·3578	1·203	5·3681	1·241	6·4152	1·279	7·5007
1·165	4·3847	1·204	5·3941	1·242	6·4401	1·280	7·5307
1·166	4·4115	1·205	5·4203	1·243	6·4650	1·281	7·5600
1·167	4·4383	1·206	5·4462	1·244	6·4902	1·282	7·5891
1·168	4·4652	1·207	5·4720	1·245	6·5153	1·283	7·6180
1·169	4·4923	1·208	5·4979	1·246	6·5402	1·284	7·6469
1·170	4·5201	1·209	5·5239	1·247	6·5651	1·285	7·6758
1·171	4·5460	1·210	5·5506	1·248	6·5903	1·286	7·7048
1·172	4·5722	1·211	5·5786	1·249	6·6152	1·287	7·7331
1·173	4·5983	1·212	5·6071	1·250	6·6402	1·288	7·7620
1·174	4·6242	1·213	5·6360	1·251	6·6681	1·289	7·7910
1·175	4·6505	1·214	5·6651	1·252	6·6960	1·290	7·8201
1·176	4·6764	1·215	5·6942	1·253	6·7240	1·291	7·8482
1·177	4·7023	1·216	5·7233	1·254	6·7521	1·292	7·8763
1·178	4·7281	1·217	5·7522	1·255	6·7800	1·293	7·9042
1·179	4·7539	1·218	5·7814	1·256	6·8081	1·294	7·9321
1·180	4·7802	1·219	5·8108	1·257	6·8362	1·295	7·9600
1·181	4·8051	1·220	5·8401	1·258	6·8643	1·296	7·9879
1·182	4·8303	1·221	5·8680	1·259	6·8921	1·297	8·0150
1·183	4·8554	1·222	5·8962	1·260	6·9201	1·298	8·0448
1·184	4·8802	1·223	5·9242	1·261	6·9510	1·299	8·0719
1·185	4·9051	1·224	5·9523	1·262	6·9822	1·300	8·1001
1·186	4·9300						

Name.	K Absolute.	K 3·86.	Factor for Absolute. (Cu = 63·2.)	Logarithms.
Sucrose	..	..	Cu × 0·5127	$\bar{1}$·70987
"			CuO × 0·4091	$\bar{1}$·61186
"			Cu_2O × 0·4551	$\bar{1}$·65811
Maltose	57·12	56·25	Cu × 0·9141	$\bar{1}$·90097
"			CuO × 0·7294	$\bar{1}$·86296
"			Cu_2O × 0·8114	$\bar{1}$·90921
Lactose (anhydr.)	72·36	70·01	Cu × 0·7216	$\bar{1}$·85828
" "			CuO × 0·5758	$\bar{1}$·76027
" "			Cu_2O × 0·6405	$\bar{1}$·80652
" (cryst.)	68·75	66·50	Cu × 0·7596	$\bar{1}$·88056
" "			CuO × 0·6061	$\bar{1}$·78255
" "			Cu_2O × 0·6742	$\bar{1}$·82880
Dextrose	100	100·8	Cu × 0·5222	$\bar{1}$·71780
"			CuO × 0·4167	$\bar{1}$·61979
"			Cu_2O × 0·4635	$\bar{1}$·66604
Laevulose	93·50	91·83	Cu × 0·5585	$\bar{1}$·74699
"			CuO × 0·4456	$\bar{1}$·64898
"			Cu_2O × 0·4957	$\bar{1}$·69523
Invert sugar	96·75	96·25	Cu × 0·5397	$\bar{1}$·73215
"			CuO × 0·4307	$\bar{1}$·63414
"			Cu_2O × 0·4791	$\bar{1}$·68039
Starch or dextrin	..	..	Cu × 0·4699	1·67204
"			CuO × 0·3750	$\bar{1}$·57403
"			Cu_2O × 0·4171	$\bar{1}$·62028

K is the specific cupric reducing power referred to dextrose as 100; K 3·86 means that the solid matter is particular

Factor for 3·86. (Cu = 63·2.)		1 Gram of Absolute.		1 Gram of 3·86.	
	Logarithms.	Grams.	Logarithms.	Grams.	Logarithms.
Cu × 0·5114	$\bar{1}$·70874	1·950 Cu	0·29013	1·956 Cu	0·29126
CuO × 0·4081	$\bar{1}$·61073	2·444 CuO	0·38814	2·451 CuO	0·38927
Cu_2O × 0·4539	$\bar{1}$·65698	2·197 Cu_2O	0·34189	2·203 Cu_2O	0·34302
Cu × 0·9283	$\bar{1}$·96767	1·094 Cu	0·03903	1·077 Cu	0·03233
CuO × 0·7407	$\bar{1}$·86966	1·371 CuO	0·13704	1·350 CuO	0·13034
Cu_2O × 0·8240	$\bar{1}$·91591	1·233 Cu_2O	0·09079	1·214 Cu_2O	0·08409
Cu × 0·7459	$\bar{1}$·87267	1·386 Cu	0·14172	1·341 Cu	0·12733
CuO × 0·5952	$\bar{1}$·77466	1·737 CuO	0·23973	1·680 CuO	0·22534
Cu_2O × 0·6621	$\bar{1}$·82091	1·561 Cu_2O	0·19348	1·510 Cu_2O	0·17909
Cu × 0·7851	$\bar{1}$·89495	1·317 Cu	0·11954	1·274 Cu	0·10505
CuO × 0·6265	$\bar{1}$·79694	1·650 CuO	0·21745	1·596 CuO	0·20306
Cu_2O × 0·6969	$\bar{1}$·84319	1·483 Cu_2O	0·17120	1·435 Cu_2O	0·15681
Cu × 0·5181	$\bar{1}$·71441	1·915 Cu	0·28220	1·930 Cu	0·28559
CuO × 0·4134	$\bar{1}$·61640	2·400 CuO	0·38021	2·419 CuO	0·38360
Cu_2O × 0·4599	$\bar{1}$·66665	2·158 Cu_2O	0·33396	2·174 Cu_2O	0·33735
Cu × 0·5686	$\bar{1}$·75480	1·791 Cu	0·25301	1·759 Cu	0·24520
CuO × 0·4537	$\bar{1}$·65679	2·244 CuO	0·35102	2·204 CuO	0·34321
Cu_2O × 0·5047	$\bar{1}$·70304	2·017 Cu_2O	0·30477	1·981 Cu_2O	0·29696
Cu × 0·5425	$\bar{1}$·73439	1·853 Cu	0·26785	1·843 Cu	0·26561
CuO × 0·4329	$\bar{1}$·63638	2·322 CuO	0·36586	2·310 CuO	0·36362
Cu_2O × 0·4815	$\bar{1}$·68263	2·087 Cu_2O	0·31961	2·077 Cu_2O	0·31737
Cu × 0·4809	$\bar{1}$·68205	2·128 Cu	0·32796	2·079 Cu	0·31795
CuO × 0·3837	$\bar{1}$·58404	2·667 CuO	0·42597	2·606 CuO	0·41596
Cu_2O × 0·4629	$\bar{1}$·63029	2·397 Cu_2O	0·37972	2·343 Cu_2O	0·36971

determined by the 3·86 divisor, and K absolute that the determination has been made by the true divisor for the carbohydrate.

SECTION XIII.—MISCELLANEOUS.

(A) *PHYSICAL.*

LINEAR EXPANSION OF DIFFERENT SUBSTANCES.

From 0° to 100° C. (32°–212° F.).

Brass	0·001868	1 : 535
Charcoal from oak	0·001200	1 : 833
„ fir	0·00100	1 : 1000
Copper	0·001718	1 : 582
Glass, flint	0·000817	1 : 1219
„ white	0·000861	1 : 1161
„ green	0·000766	1 : 1305
Gold	0·001466	1 : 682
Iron, wrought	0·001235	1 : 812
„ cast	0·001110	1 : 901
Lead	0·002848	1 : 351
Marble of Carrara	0·000849	1 : 1178
„ St. Beat	0·000418	1 : 2392
Platinum	0·000884	1 : 1132
Silver	0·001908	1 : 524
Solder, hard	0·002058	1 : 486
Steel, hardened	0·001240	1 : 807
„ not hardened	0·001079	1 : 927
Tin	0·001938	1 : 516
Water	0·015538	1 : 71·4
Zinc	0·002942	1 : 340

COEFFICIENTS OF EXPANSION (LINEAR) OF

—	Glass.	Brass.
1	·000007567	·000018782
2	·000015133	·000037564
3	·000022700	·000056346
4	·000030267	·000075128
5	·000037833	·000093910
6	·000045400	·000112692
7	·000052967	·000131474
8	·000060533	·000150256
9	·000068100	·000169038

TABLE SHOWING THE VARIATION OF BOILING POINT OF WATER WITH ATMOSPHERIC PRESSURE.

Boiling Point.		Atmospheric Pressure.	
°C.	°Fahr.	Millimetres.	Inches.
98·5	209·30	720·15	28·352
98·6	209·48	722·75	28·455
98·7	209·66	725·35	28·557
98·8	209·84	727·96	28·660
98·9	210·02	730·58	28·763
99·0	210·20	733·21	28·866
99·1	210·38	735·85	28·970
99·2	210·56	738·50	29·075
99·3	210·74	741·16	29·179
99·4	210·92	743·83	29·285
99·5	211·10	746·50	29·390
99·6	211·28	749·18	29·495
99·7	211·46	751·87	29·601
99·8	211·64	754·57	29·707
99 9	211·82	757·28	29·814
100·0	212·00	760·00	29·921
100·1	212·18	762·73	30·029
100·2	212·36	765·46	30·137
100·3	212·54	768·20	30·244
100·4	212·72	771·95	30·392

TABLE OF THE FUSING POINTS OF VARIOUS SUBSTANCES.

	° C.		° C.
Yellow bees'-wax	63·4	Hg	−39
White „	61·8	P.	44
Paraffin	49·6	Pb	332
	52·5–54	S	115
	53	I	107
	52·7–53·2	Bi	270
Spermaceti	43·5	Cd	320
	44·1	Sn	235
Stearic acid	55·3	Ag	1000
	56·2	Zn	433
	56	$CaCl_2, 3H_2O$	28·5
Japan wax	50·4–51	KNO_3	353
Cacao butter	33·5	$NaNO_3$	310·5
Nutmeg butter	70–80	$KClO_3$	372
Mutton suet	46·5–47·4	KCl	434
Beef suet	43·5–45	KI	639
Ceresin	71·35	KBr	703
Stearin	51·45	K_2CO_3	838
Succinic acid	180	AsI_3	146
Adipic „	148	H_3BO_3	186
Suberic „	140	$AgNO_3$	217
Sebic „	127	COHO.COHO	203
Pyrotartaric „	97	$HgBr_2$	242
a Pimetic „	102	$LiNO_3$	267
a Zelaic „	108	Tl_2CO_3	273
Acetic „	17	$HgCl_2$	293
Butyric „	0	SbF_3	292
Caproic „	−2	$NaClO_3$	302
Caprylic „	16	PbI_2	383
Capric „	30	$ZnBr_2$	394
Palmitic „	62	CdI_2	404
Stearic „	69·2	$Ba(ClO_3)_2$	414
Œnanthylic „	−10·5	AgBr	427
		TlCl	427
Pelargonic „	12	Ag_3VO_4	403–565
Margaric „	59·9	Cu_2Cl_2	434

FUSING POINTS OF VARIOUS SUBSTANCES—*continued.*

	° C.		° C.
TlI	439	KI	634
LiI	446	RbI	642
ZnI_2	446	$Sr(NO_3)_2$	645
AgCl	451	$Na_4V_2O_7$	654
TlBr	458	Ag_2SO_4	654
$AgPO_3$	482	V_2O_5	658
$CuCl_2$	498	$CaBr_2$	676
$PbCl_2$	498	RbBr	683
$PbBr_2$	499	Li_2CO_3	695
SrI_2	507	$MgBr_2$	695
CdF_2	520	KBr	699
AgI	527	NaBr	708
$CdCl_2$	541	$MgCl_2$	708
LiBr	547	RbCl	710
$Cu(NO_3)_2$	561	$CaCl_2$	719
$Na_2B_4O_7$	561	KCl	734
$NaVO_3$	562	ZnF_2	734
$Na_{12}V_8O_{26}$	562	RbF	753
Tl_3VO_4	566	MoO_3	759
$CdBr_2$	571	NaCl	772
$Ba(NO_3)_2$	593	KF	789
B_2O_3	577	$Pb(PO_3)_2$	800
$Ag_4P_2O_7$	585	LiF	801
LiCl	598	$Pb_2P_2O_7$	806
Cu_2I_2	601	$BaBr_2$	812
$NaPO_3$	617	Na_2CO_3	814
NaI	628	Li_2SO_4	818
$SrBr_2$	630	$SrCl_2$	825
CaI_2	631	K_2CO_3	834
Tl_2SO_4	632	Na_2SO_4	861

NOTE.—This table may be used to ascertain the temperature of furnaces, etc. A selection of salts is made and the temperature found by observing the behaviour of the salts in the furnace.

TENSIONS OF THE VAPOURS OF SOME LIQUIFIABLE GASES IN CENTIMETRES OF MERCURY AT VARIOUS TEMPERATURES C.

Temperature.	Sulphurous Anhydride.	Ammonia.	Carbonic Anhydride.	Nitrous Oxide.	Cyanogen.
−30	28·7	86	—	—	—
−20	48·	140	1515	1570	79
−10	76·3	215	2035	2200	140
0	116·5	318	2700	2740	204
10	180·	457	3500	3420	290
30	343·	870	5610	5170	—
50	622·	1516	—	—	—
100	—	—	—	—	—
120	—	—	—	—	—
150	—	—	—	—	—
Boiling point °C under 760 mm.	−10·08	−38·5	−78·2	−87·9	−20·7

Temperature.	Alcohol.	Ether.	Chloroform.	Benzine.	Ethyl Chloride.	Ethyl Iodide.
−30	—	—	—	—	11·	—
−20	·34	6·9	—	·58	18·8	—
−10	·64	11·5	—	1·3	30·2	—
0	1·27	18·4	—	2·5	46·5	4·2
10	2·42	28·7	16	4·5	69·1	6·9
30	7·85	63·5	37	12	139·9	16·9
50	22·0	126·5	75·5	27·1	257·9	36·4
100	169·7	495·	311	134	872·3	—
120	232·2	772·	488	223·5	—	—
150	731·8	—	873	433	—	—
Boiling point °C under 760 mm.	78·26	34·97	60·16	80·36	12·5	72·2

TABLE SHOWING THE SPECIFIC GRAVITY OF GASES AND VAPOURS.

Gas.	—	Molecular Weight.	Sp. Gr. Air = 1.	Grams per litre at 760 mm. and 0° C.	Grains per cubic foot. 29·92″ and 32° F.	Lbs. per cubic foot. 29·92″ and 32° F.
Ammonia	NH_3	17	0·58890	0·76199	332·96	·04757
Atmospheric air	..	..	1·00000	1·293909	565·16	·08074
Bromine	Br_2	160	5·52271	7·14588	3122·1	·4460
Chlorine	Cl_2	71	2·44921	3·16906	1384·73	·1978
Carbonic oxide	CO	28	0·96709	1·25133	546·78	·07811
Carbonic anhydride ..	CO_2	44	1·51968	1·96633	859·21	·12274
Ethylene	C_2H_4	28	0·96744	1·25178	546·98	·07814
Hydrogen	H_2	2	0·06923	0·08958	39·1439	·0055919
,, chloride ..	HCl	36·5	1·25922	1·62932	711·94	·1017
Iodine	I_2	254	8·756	11·328	4949·00	·7071
Methane	CH_4	16	0·55297	0·71549	312·64	·04466
Mercury	Hg	200	..	8·9582	3914·39	·5592
Nitrogen	N_2	28	0·97010	1·25523	548·47	·07835
Nitrous oxide	N_2O	44	1·52269	1·97023	860·90	·1229
Nitric oxide	NO	30	1·03767	1·34261	586·66	·08381
Nitrous anhydride ..	N_2O_3	76	2·630	3·40412	1487·46	·2125
Nitric peroxide	NO_2	46	1·592	2·06039	900·31	·1286
,, ...	N_2O_4	92	3·184	4·12078	1800·63	·2572
Oxygen	O_2	32	1·10521	1·43003	624·85	·08926
Sulphuretted hydrogen	H_2S	34	1·17697	1·52290	665·44	·09506
Sulphurous anhydride ..	SO_2	64	2·21295	2·86336	1251·19	·1787
Sulphur	S_2	64	2·2155	2·86663	1252·59	·1789
Water	H_2O	18	0·62182	0·80458	351·57	·05022

The molecular weight of a gas divided by 4, approximately indicates the weight of 10,000 cubic feet in cwts. Thus, 10,000 cubic feet of sulphuretted hydrogen weigh $\frac{34}{4} = 8{\cdot}5$ (8·488) cwts.

(B) *TECHNICAL.*

TABLE SHOWING THE WEIGHTS OF MISCELLANEOUS SUBSTANCES (LUNGE).

Name.	1 cubic metre.	1 cubic foot.	Tons per cubic foot.
	kilo.	lbs.	
Alkali waste (wet)	1268	79	·0352
Bricks	2100	131	·0584
Black ash, lumps	962	60	·0268
Bleaching powder	721–834	45–52	·0216
Cement	1200	75	·0335
Cinders	738	46	·0205
Clay, damp	1650	103	·0459
„ dry	1570	98	·0437
Coke	417–534	26–33	·0131
Flint for towers	1600	100	·0446
Limestone for building	2000	125	·0558
„ small pieces	1400	87·5	·0391
„ dust	1550	96·5	·0431
Manganese, native	2210	138	·0616
Mortar	1800	112	·0500
Nitre	1310	81·5	·0364
Nitre cake	1335	83	·0375
Pyrites, broken pieces	2500	156	·0696
„ smalls	2340	146·5	·0654
„ burnt	1520	95	·0424
Quicklime	1000	62·5	·0279
„ sieved	497–593	31–37	·0151
Salt	689	43	·0192
Salt cake	1180	73·5	·0328
Sand, dry	1330	83	·0370
„ damp	1770	110	·0491
Soda ash, not ground	1195	74·5	·0332
„ bicarbonate, ground	986	61·5	·0274
„ crystals	1010	63	·0281
„ salts ($Na_2CO_3 + H_2O$), drained	810	50·5	·0225
Wood, fir logs	330	20·5	·0091
„ oak logs	420	26	·0116

A.—TABLES FOR THE SPEED OF CURRENTS OF AIR (LUNGE),

At a temperature of 15° C. = 60° F.; barometer, 760 mm. = 29·92 inches.

(A) READINGS IN INCHES.

Anemometer Reading.	Speed per Second.	Anemometer Reading.	Speed per Second.	Anemometer Reading.	Speed per Second.	Anemometer Reading.	Speed per Second.
inches	feet	inches	feet	inches	feet	inches	feet
0·01	2·885	0·14	10 68	0·27	14·84	0·65	23·02
0·02	4·038	0·15	11·06	0·28	15·11	0·70	23·89
0·03	4·945	0·16	11·42	0·29	15·38	0·75	24·73
0·04	5·710	0·17	11·77	0·30	15·64	0·80	25·54
0·05	6·384	0·18	12·11	0·32	16·15	0·85	26·32
0·06	6·993	0·19	12·45	0·34	16·65	0·90	27·08
0·07	7·554	0·20	12·77	0·36	17·13	0·95	27·83
0·08	8·075	0·21	13·08	0·38	17·60	1·00	28·55
0·09	8·565	0·22	13·39	0·40	18·06	1·25	31·93
0·10	9·028	0·23	13·70	0·45	19·15	1·50	34·97
0·11	9·469	0·24	13·99	0·50	20·18	1·75	37·77
0·12	9·891	0·25	14·28	0·55	21·17	2·00	40·37
0·13	10·29	0·26	14·56	0·60	22·12		

TABLES FOR THE SPEED OF CURRENTS OF AIR (LUNGE)—*continued.*

(B) READINGS IN MILLIMETRES.

Reading.	Speed.	Reading.	Speed.	Reading.	Speed.	Reading.	Speed.	Reading.	Speed.	Reading.	Speed.
mm.	m.	mm.	m.	mm.	m.	mm.	m.	mm.	m.	mm.	m.
0·1	0·575	1·4	2·040	2·7	2·833	5·0	3·855	10·0	5·452	19·0	7·515
0·2	0·771	1·5	2·111	2·8	2·885	5·2	3·931	10·5	5·586	20·0	7·710
0·3	0·944	1·6	2·181	2·9	2·935	5·4	4·006	11·0	5·718	21·0	7·900
0·4	1·090	1·7	2·248	3·0	2·986	5·6	4·080	11·5	5·846	22·0	8·806
0·5	1·205	1·8	2·313	3·2	3·077	5·8	4·152	12·0	5·972	23·0	8·268
0·6	1·341	1·9	2·376	3·4	3·179	6·0	4·223	12·5	6·095	24·0	8·446
0·7	1·442	2·0	2·438	3·6	3·271	6·5	4·395	13·0	6·216	25·0	8·620
0·8	1·560	2·1	2·498	3·8	3·361	7·0	4·561	13·5	6·334	30·0	9·443
0·9	1·636	2·2	2·557	4·0	3·448	7·5	4·721	14·0	6·450	35·0	10·199
1·0	1·724	2·3	2·615	4·2	3·469	8·0	4·876	15·0	6·667	40·0	10·903
1·1	1·808	2·4	2·671	4·4	3·616	8·5	5·026	16·0	6·896	45·0	11·565
1·2	1·889	2·5	2·726	4·6	3·698	9·0	5·172	17·0	7·108	50·0	12·190
1·3	1·966	2·6	2·779	4·8	3·777	9·5	5·314	18·0	7·314		

B.—CORRECTIONS FOR TEMPERATURE.

Column *a* shows the temperature of the chimney or flue, column *b* the factor for multiplying the figure found in Table A in order to arrive at the real speed of the current of gas.

(A) READINGS IN DEGREES FAHRENHEIT.

a	*b*	*a*	*b*	*a*	*b*	*a*	*b*
0	1·0634	90	0·9723	180	0·9012	380	0·7865
5	1·0577	95	0·9679	185	0·8977	400	0·7763
10	1·0520	100	0·9636	190	0·8943	425	0·7663
15	1·0464	105	0·9593	195	0·8909	450	0·7556
20	1·0409	110	0·9551	200	0·8875	475	0·7454
25	1·0355	115	0·9509	210	0·8808	500	0·7356
30	1·0302	120	0·9468	220	0·8743	525	0·7261
35	1·0250	125	0·9428	230	0·8680	550	0·7171
40	1·0198	130	0·9388	240	0·8614	575	0·7085
45	1·0148	135	0·9348	250	0·8557	600	0·7000
50	1·0098	140	0·9309	260	0·8497	650	0·6841
55	1·0049	145	0·9270	270	0·8438	700	0·6691
60	1·0000	150	0·9232	280	0·8380	750	0·6552
65	0·9952	155	0·9194	290	0·8324	800	0·6420
70	0·9905	160	0·9156	300	0·8269	850	0·6297
75	0·9858	165	0·9119	320	0·8163	900	0·6181
80	0·9812	170	0·9083	340	0·8060	950	0·6070
85	0·9767	175	0·9047	360	0·7960	1000	0·5964

CORRECTIONS FOR TEMPERATURE—*continued.*

(B) READINGS IN DEGREES CENTIGRADE.

a	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*
−10	1·046	18	0·995	42	0·956	66	0·922	140	0·835	260	0·735
− 5	1·536	20	0·991	44	0·953	68	0·919	150	0·825	270	0·728
0	1·027	22	0·988	46	0·950	70	0·916	160	0·815	280	0·721
2	1·023	24	0·985	48	0·947	75	0·909	170	0·806	290	0·715
4	1·020	26	0·981	50	0·944	80	0·903	180	0·797	300	0·709
6	1·016	28	0·978	52	0·941	85	0·897	190	0·788	320	0·697
8	1·012	30	0·975	54	0·938	90	0·890	200	0·780	340	0·685
10	1·009	32	0·972	56	0·935	95	0·884	210	0·772	360	0·676
12	1·005	34	0·968	58	0·933	100	0·878	220	0·764	400	0·654
14	1·003	36	0·965	60	0·930	110	0·867	230	0·756	450	0·631
15	1·000	38	0·962	62	0·927	120	0·856	240	0·749	500	0·603
16	0·998	40	0·959	64	0·924	130	0·845	250	0·742		

TABLE FOR THE COMPARISON OF FRENCH, GERMAN AND ENGLISH COMMERCIAL ALKALI-METRICAL DEGREES (J. Pattinson).

Real Soda, Na_2O.	German degrees, Na_2CO_3.	New-castle degrees.	French degrees.	Real Soda, Na_2O.	German degrees, Na_2CO_3.	New-castle degrees.	French degrees.
0·5	0·85	0·51	0·79	20	34·20	20·26	31·61
1	1·71	1·01	1·58	20·5	35·05	20·77	32·40
1·5	2·56	1·52	2·37	21	35·91	21·27	33·19
2	3·42	2·03	3·16	21·5	36·76	21·78	33·98
2·5	4·27	2·54	3·95	22	37·62	22·29	34·77
3	5·13	3·04	4·74	22·5	38·47	22·80	35·56
3·5	5·98	3·55	5·53	23	39·33	23·30	36·35
4	6·84	4·05	6·32	23·5	40·18	23·81	37·14
4·5	7·69	4·56	7·11	24	41·04	24·31	37·93
5	8·55	5·06	7·90	24·5	41·89	24·82	38·72
5·5	9·40	5·57	8·69	25	42·75	25·32	39·51
6	10·26	6·08	9·48	25·5	43·60	25·83	40·30
6·5	11·11	6·59	10·27	26	44·46	26·34	41·09
7	11·97	7·09	11·06	26·5	45·31	26·85	41·88
7·5	12·82	7·60	11·85	27	46·17	27·35	42·67
8	13·68	8·10	12·64	27·5	47·02	27·86	43·46
8·5	14·53	8·61	13·43	28	47·88	28·36	44·25
9	15·39	9·12	14·22	28·5	48·73	28·37	45·04
9·5	16·24	9·63	15·01	29	49·59	29·38	45·83
10	17·10	10·13	15·81	29·5	50·44	29·89	46·62
10·5	17·95	10·64	16·60	30	51·29	30·39	47·42
11	18·81	11·14	17·39	30·5	52·14	30·90	48·21
11·5	19·66	11·65	18·18	31	53·00	31·41	49·00
12	20·52	12·17	18·97	31·5	53·85	31·91	49·79
12·5	21·37	12·68	19·76	32	54·71	32·42	50·88
13	22·23	13·17	20·55	32·5	55·56	32·92	51·37
13·5	23·08	13·68	21·34	33	56·42	33·43	52·16
14	23·94	14·18	22·13	33·5	57·27	33·94	52·95
14·5	24·79	14·69	22·92	34	58·13	34·44	53·74
15	25·65	15·19	23·71	34·5	58·98	34·95	54·53
15·5	26·50	15·70	24·50	35	59·84	35·46	55·32
16	27·36	16·21	25·29	35·5	60·69	35·96	56·11
16·5	28·21	16·73	26·08	36	61·55	36·47	56·90
17	29·07	17·22	26·87	36·5	62·40	36·98	57·69
17·5	29·92	17·73	27·66	37	63·26	37·48	58·48
18	30·78	18·23	28·45	37·5	64·11	37·98	59·27
18·5	31·63	18·74	29·24	38	64·97	38·50	60·06
19	32·49	19·25	30·03	38·5	65·82	39·00	60·85
19·5	33·34	19·76	30·82	39	66·68	39·51	61·64

TABLE FOR COMPARISON OF ALKALI-METRICAL DEGREES—*contd.*

Real Soda, Na_2O.	German degrees, Na_2CO_3.	New-castle degrees.	French degrees.	Real Soda, Na_2O.	German degrees. Na_2CO_3.	New-castle degrees.	French degrees.
39·5	67·53	40·02	62·43	59	100·87	59·77	93·26
40	68·39	40·52	63·22	59·5	101·73	60·28	94·05
40·5	69·24	41·03	64·01	60	102·58	60·79	94·84
41	70·10	41·54	64·81	60·5	103·44	61·30	95·63
41·5	70·95	42·04	65·60	61	104·30	61·80	96·42
42	71·81	42·55	66·39	61·5	105·15	62·31	97·21
42·5	72·66	43·06	67·18	62	106·01	62·82	98·00
43	73·52	43·57	67·97	62·5	106·86	63·32	98·79
43·5	74·37	44·07	68·76	63	107·72	63·83	99·58
44	75·23	44·58	69·55	63·5	108·57	64·33	100·37
44·5	76·08	45·08	70·34	64	109·43	64·84	101·16
45	76·94	45·69	71·13	64·5	110·28	65·35	101·95
45·5	77·80	46·10	71·92	65	111·14	65·85	102·74
46	78·66	46·60	72·71	65·5	111·99	66·36	103·53
46·5	79·51	47·11	73·50	66	112·85	66·87	104·32
47	80·37	47·62	74·29	66·5	113·70	67·37	105·11
47·5	81·22	48·12	75·08	67	114·56	67·88	105·90
48	82·07	48·63	75·87	67·5	115·41	68·39	106·69
48·5	82·93	49·14	76·66	68	116·27	68·99	107·48
49	83·78	49·64	77·45	68·5	117·12	69·40	108·27
49·5	84·64	50·15	78·24	69	117·98	69·91	109·06
50	85·48	50·66	79·03	69·5	118·83	70·41	109·85
50·5	86·34	51·16	79·82	70	119·69	70·92	110·64
51	87·19	51·67	80·61	70·5	120·53	71·43	111·43
51·5	88·05	52·18	81·40	71	121·39	71·93	112·23
52	88·90	52·68	82·19	71·5	122·24	72·44	113·02
52·5	89·76	53·19	82·98	72	123·10	72·95	113·81
53	90·61	53·70	83·77	72·5	123·95	73·45	114·60
53·5	91·47	54·20	84·56	73	124·81	73·96	115·39
54	92·32	54·71	85·35	73·5	125·66	74·47	116·18
54·5	93·18	55·22	86·14	74	126·52	74·97	116·97
55	94·03	55·72	86·93	74·5	127·37	75·48	117·76
55·5	94·89	56·23	87·72	75	128·23	75·99	118·55
56	95·74	56·74	88·52	75·5	129·08	76·49	119·34
56·5	96·60	57·24	89·31	76	129·94	77·00	120·13
57	97·45	57·75	90·10	76·5	130·79	77·51	120·92
57·5	98·31	58·26	90·89	77	131·65	78·01	121·71
58	59·16	58·76	91·68	77·5	132·50	78·52	122·50
58·5	100·02	59·27	92·47				

TABLE (BY MR. J. PATTINSON) SHOWING A COMPARISON OF THE ENGLISH AND FRENCH CHLOROMETRIC DEGREES.

The French Degrees indicate how many litres, at 0° C. and 760 mm., are yielded by 1 kilo. of the Bleaching Powder.

The English Degrees, which are also used in Germany, in Russia, and in America, show the percentage of "active" Chlorine.

French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.
63	20·02	85	27·01	107	34·00
64	20·34	86	27·33	108	34·32
65	20·65	87	27·65	109	34·64
66	20·97	88	27·96	110	34·95
67	21·29	89	28·28	111	35·27
68	21·61	90	28·60	112	35·59
69	21·93	91	28·92	113	35·91
70	22·24	92	29·23	114	36·22
71	22·56	93	29·55	115	36·54
72	22·88	94	29·87	116	36·86
73	23·20	95	30·19	117	37·18
74	23·51	96	30·51	118	37·50
75	23·83	97	30·83	119	37·81
76	24·15	98	31·14	120	38·13
77	24·47	99	31·46	121	38·45
78	24·79	100	31·78	122	38·77
79	25·10	101	32·09	123	39·08
80	25·42	102	32·41	124	39·40
81	25·74	103	32·73	125	39·72
82	26·06	104	33·05	126	40·04
83	26·37	105	33·36	127	40·36
84	26·69	106	33·68	128	40·67

TABLE FOR PROPORTION OF BASES IN MANGANESE MUD.

This is used in the analysis of manganese mud to determine the proportion of bases to MnO_2. A certain volume of the mud being taken, then the number of grains of crystallized ferrosum sulphate is to the number of grains of crystallized oxalic acid decomposed and neutralized as 100 is to a figure in column A of the table. Opposite this figure in column B is the proportion of bases per equivalent of MnO_2.

A.	B.	A.	B.	A.	B.
69·5	1·066	65·00	·868	60·50	·670
69·25	1·055	64·75	·857	60·25	·659
69·00	1·044	64·50	·846	60·00	·648
68·75	1·033	64·25	·835	59·75	·637
68·50	1·022	64·00	·824	59·50	·626
68·25	1·011	63·75	·813	59·25	·615
68·00	1·000	63·50	·802	59·00	·604
67·75	·989	63·25	·791	58·75	·593
67·50	·978	63·00	·780	58·50	·582
67·25	·967	62·75	·769	58·25	·571
67·00	·956	62·50	·758	58·00	·560
66·75	·945	62·25	·747	57·75	·549
66·50	·934	62·00	·736	57·50	·538
66·25	·923	61·75	·725	57·25	·527
66·00	·912	61·50	·714	57·00	·516
65·75	·901	61·25	·703	56·75	·505
65·50	·890	61·00	·692	56·50	·494
65·25	·879	60·75	·681	56·25	·483

1 litre of chlorine at 0° C. and 760 mm. pressure weighs 3·17 grams.

1 c.c. $\frac{N}{10}$ arsenious or thiosulphate solution = ·00355 grm. Cl.

1·2267 grm. MnO_2 = 1 grm. Cl.

TABLE (BY MR. E. JACKSON) SHOWING FROM THE PERCENTAGE OF OXYGEN FOUND THE NUMBER OF CUBIC FEET OF RESIDUAL GASES PASSING AWAY FROM THE SULPHURIC ACID CHAMBERS PER TON OF STONE BURNT.

This Table is calculated on the assumption that 45 per cent. of sulphur is available, but can be made to answer for any other percentage by multiplying the number in the Table by the percentage of sulphur consumed and dividing by 45.

Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.	Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.	Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.
·1	85451	3·2	100474	6·3	121905
·2	85865	3·3	101047	6·4	122749
·3	86283	3·4	101626	6·5	123606
·4	86706	3·5	102212	6·6	124474
·5	87132	3·6	102805	6·7	125355
·6	87562	3·7	103406	6·8	126248
·7	87998	3·8	104013	6·9	127155
·8	88437	3·9	104627	7·0	128074
·9	88881	4·0	105248	7·1	129006
1·0	89328	4·1	105877	7·2	129953
1·1	89781	4·2	106514	7·3	130913
1·2	90238	4·3	107158	7·4	131887
1·3	90701	4·4	107810	7·5	132876
1·4	91167	4·5	108471	7·6	133881
1·5	91639	4·6	109138	7·7	134900
1·6	92115	4·7	109816	7·8	135935
1·7	92597	4·8	110500	7·9	136986
1·8	93083	4·9	111194	8·0	138053
1·9	93575	5·0	111896	8·1	139138
2·0	94072	5·1	112607	8·2	140239
2·1	94574	5·2	113327	8·3	141358
2·2	95082	5·3	114057	8·4	142494
2·3	95594	5·4	114796	8·5	143650
2·4	96113	5·5	115544	8·6	144824
2·5	96637	5·6	116303	8·7	146018
2·6	97167	5·7	117072	8·8	147232
2·7	97703	5·8	117850	8·9	148465
2·8	98245	5·9	118639	9·0	149719
2·9	98793	6·0	119439	9·1	150996
3·0	99346	6·1	120250	9·2	152294
3·1	99907	6·2	121072	9·3	153614

TABLE BY MR. E. JACKSON—*continued.*

Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.	Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.	Oxygen, per cent.	Residual Gases. Cubic Feet per Ton of Stone.
9·4	154958	13·0	226172	16·6	418508
9·5	156325	13·1	229097	16·7	428634
9·6	157716	13·2	232099	16·8	439261
9·7	159134	13·3	235175	16·9	450429
9·8	160575	13·4	238343	17·0	462178
9·9	162045	13·5	241593	17·1	474558
10·0	163540	13·6	244932	17·2	487620
10·1	165064	13·7	248366	17·3	501420
10·2	166616	13·8	250899	17·4	516025
10·3	168198	13·9	255531	17·5	531506
10·4	169810	14·0	259271	17·6	547944
10·5	171453	14·1	263121	17·7	565431
10·6	173129	14·2	267088	17·8	584073
10·7	174837	14·3	271176	17·9	603983
10·8	176581	14·4	275391	18·0	625301
10·9	178358	14·5	279740	18·1	648178
11·0	180171	14·6	284227	18·2	672793
11·1	182023	14·7	288861	18·3	699348
11·2	183912	14·8	293649	18·4	728090
11·3	185841	14·9	298598	18·5	759294
11·4	187811	15·0	303717	18·6	793291
11·5	189823	15·1	309015	18·7	830479
11·6	191879	15·2	314500	18·8	871320
11·7	193919	15·3	320183	18·9	916389
11·8	196128	15·4	326076	19·0	966373
11·9	198323	15·5	332190	19·1	1022127
12·0	200568	15·6	338538	19·2	1084707
12·1	202865	15·7	345133	19·3	1155447
12·2	205214	15·8	351990	19·4	1236062
12·3	207619	15·9	359126	19·5	1328762
12·4	210081	16·0	366555	19·6	1436501
12·5	212602	16·1	374300	19·7	1563252
12·6	215184	16·2	382378	19·8	1714534
12·7	217830	16·3	390812	19·9	1898234
12·8	220541	16·4	399628	20·0	2126024
12·9	223322	16·5	408851		

TABLE FOR MILK ANALYSIS (Muter),

To find the sp. gr. of Milk at 60° Fahr. from its sp. gr. at any Temperature between 50° and 70° Fahr. (water=1000).

°Fah.	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035
50	19·2	20·2	21·2	22·2	23·2	24·1	25·1	26·1	27·0	28·0	29·0	29·9	30·9	31·8	32·7	33·6
51	·3	·3	·3	·3	·3	·2	·2	·2	·1	·1	·1	30·0	31·0	·9	·9	·8
52	·4	·3	·3	·3	·3	·3	·2	·2	·2	·2	·1	·1	·1	32·0	33·0	·9
53	·4	·4	·4	·4	·4	·4	·3	·3	·3	·3	·2	·2	·2	·1	·1	34·0
54	·5	·5	·5	·5	·5	·5	·4	·4	·4	·4	·3	·3	·3	·3	·2	·2
55	·6	·6	·6	·6	·6	·6	·5	·5	·5	·5	·4	·4	·4	·4	·3	·3
56	·7	·7	·7	·7	·6	·6	·6	·6	·6	·6	·6	·5	·5	·5	·5	·5
57	·8	·8	·8	·8	·7	·7	·7	·7	·7	·7	·7	·6	·6	·6	·6	·6
58	·9	·9	·9	·8	·8	·8	·8	·8	·8	·8	·8	·8	·7	·7	·7	·7
59	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9	·9
60	20·0	21·0	22·0	23·0	24·0	25·0	26·0	27·0	28·0	29·0	30·0	31·0	32·0	33·0	34·0	35·0
61	·1	·1	·1	·1	·1	·1	·1	·1	·1	·1	·1	·2	·2	·2	·2	·2
62	·2	·2	·2	·2	·2	·2	·2	·3	·3	·3	·3	·3	·3	·3	·3	·3
63	·2	·3	·3	·3	·3	·3	·3	·4	·4	·4	·4	·4	·5	·5	·5	·5
64	·3	·4	·4	·4	·4	·4	·5	·5	·5	·5	·5	·5	·6	·6	·6	·6
65	·4	·5	·5	·5	·5	·5	·6	·6	·6	·6	·7	·7	·7	·8	·8	·8
66	·5	·6	·6	·6	·6	·6	·7	·7	·7	·8	·8	·8	·9	·9	·9	·9
67	·6	·7	·7	·7	·7	·7	·8	·8	·8	·9	·9	32·0	33·0	34·0	35·0	36·1
68	·7	·8	·8	·8	·9	·9	27·0	28·0	29·0	30·1	31·1	·2	·2	·2	·2	·2
69	·9	22·0	23·0	24·0	25·0	26·0	·1	·1	·1	·2	·2	·2	·3	·3	·3	·4
70	21·0	·1	·1	·1	·1	·1	·2	·2	·2	·3	·3	·4	·4	·5	·5	·5

The observed sp. gr. is given at the top of each column, and the number in the column opposite to the temperature at which the sp. gr. was determined, added to 1000, gives the sp. gr. at 60° F.

Ex. 1. Milk of which the sp. gr. is 1032 at 54° F. is 1031·3 at 60° F.

Ex. 2. Milk of which the sp. gr. is 1028·6 at 63° F. becomes 1000 + (28·4 + 0·6) = 1029 at 60° F.

WAGES TABLE.

Wages Per Year.	= Approximately.													
	Per Half Year.			Per Quarter Year.			Per Month.			Per Week.		Per Day.	
£	£	s.	d.	£	s.	d.	£	s.	d.	s.	d.	s.	d.
1	0	10	0	0	5	0	0	1	8	0	4½	0	0¾
2	1	0	0	0	10	0	0	3	4	0	9¼	0	1¼
3	1	10	0	0	15	0	0	5	0	1	1¾	0	2
4	2	0	0	1	0	0	0	6	8	1	6½	0	2¾
5	2	10	0	1	5	0	0	8	4	1	11	0	3¼
6	3	0	0	1	10	0	0	10	0	2	3¾	0	4
7	3	10	0	1	15	0	0	11	8	2	8¼	0	4½
8	4	0	0	2	0	0	0	13	4	3	1	0	5¼
9	4	10	0	2	5	0	0	15	0	3	5½	0	6
10	5	0	0	2	10	0	0	16	8	3	10¼	0	6½
11	5	10	0	2	15	0	0	18	4	4	2¾	0	7¼
12	6	0	0	3	0	0	1	0	0	4	7¼	0	8
13	6	10	0	3	5	0	1	1	8	5	0	0	8½
14	7	0	0	3	10	0	1	3	4	5	4½	0	9¼
15	7	10	0	3	15	0	1	5	0	5	9¼	0	9¾
16	8	0	0	4	0	0	1	6	8	6	1¾	0	10½
17	8	10	0	4	5	0	1	8	4	6	6½	0	11¼
18	9	0	0	4	10	0	1	10	0	6	11	0	11¾
19	9	10	0	4	15	0	1	11	8	7	3¾	1	0½
20	10	0	0	5	0	0	1	13	4	7	8¼	1	1¼
25	12	10	0	6	5	0	2	1	8	9	7¼	1	4½
30	15	0	0	7	10	0	2	10	0	11	6½	1	7¾
35	17	10	0	8	15	0	2	18	4	13	5½	1	11
40	20	0	0	10	0	0	3	6	8	15	4½	2	2¼
45	22	10	0	11	5	0	3	15	0	17	3¾	2	5½
50	25	0	0	12	10	0	4	3	4	19	2¾	2	9

ENGLISH COINS.

A pound sterling consists of gold .. 113·001 grains.
„ „ copper .. 10·273 „
or a fineness of ·916⅔.
Total weight .. .. 123·274 „

1 shilling =87·273 grains. | 12 pence.. .. =¼ lb. avoir.
20 shillings= 3·636 oz. troy. | Or pence in £ =5 lbs. „

1 lb. troy (37 silver to 3 alloy) =66*s.*

COPPER COINAGE.—A lb. avoir. of copper is coined into 24 pence or 48 halfpence.

BRONZE COINAGE.—95 copper, 4 tin, 1 zinc, is coined into 40 pence, 80 halfpence, 160 farthings.

READY RECKONER.

1	2		3		4		5		6		7		8		9		10	
d.	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
¼	0	0½	0	0¾	0	1	0	1¼	0	1½	0	1¾	0	2	0	2¼	0	2½
½	0	1	0	1½	0	2	0	2½	0	3	0	3½	0	4	0	4½	0	5
¾	0	1½	0	2¼	0	3	0	3¾	0	4½	0	5¼	0	6	0	6¾	0	7½
1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0	10
1¼	0	2½	0	3¾	0	5	0	6¼	0	7½	0	8¾	0	10	0	11¼	1	0½
1½	0	3	0	4½	0	6	0	7½	0	9	0	10½	1	0	1	1½	1	3
1¾	0	3½	0	5¼	0	7	0	8¾	0	10½	1	0¼	1	2	1	3¾	1	5½
2	0	4	0	6	0	8	0	10	1	0	1	2	1	4	1	6	1	8
2¼	0	4½	0	6¾	0	9	0	11¼	1	1½	1	3¾	1	6	1	8¼	1	10½
2½	0	5	0	7½	0	10	1	0½	1	3	1	5½	1	8	1	10½	2	1
2¾	0	5½	0	8¼	0	11	1	1¾	1	4½	1	7¼	1	10	2	0¾	2	3½
3	0	6	0	9	1	0	1	3	1	6	1	9	2	0	2	3	2	6
3¼	0	6½	0	9¾	1	1	1	4¼	1	7½	1	10¾	2	2	2	5¼	2	8½
3½	0	7	0	10½	1	2	1	5½	1	9	2	0½	2	4	2	7½	2	11
3¾	0	7½	0	11¼	1	3	1	6¾	1	10½	2	2¼	2	6	2	9¾	3	1½
4	0	8	1	0	1	4	1	8	2	0	2	4	2	8	2	0	3	4
4¼	0	8½	1	0¾	1	5	1	9¼	2	1½	2	5¾	2	10	3	2¼	3	6½
4½	0	9	1	1½	1	6	1	10½	2	3	2	7½	3	0	3	4½	3	9
4¾	0	9½	1	2¼	1	7	1	11¾	2	4½	2	9¼	3	2	3	6¾	3	11½
5	0	10	1	3	1	8	2	1	2	6	2	11	3	4	3	9	4	2
5¼	0	10½	1	3¾	1	9	2	2¼	2	7½	3	0¾	3	6	3	11¼	4	4½
5½	0	11	1	4½	1	10	2	3½	2	9	3	2½	3	8	4	1½	4	7
5¾	0	11½	1	5¼	1	11	2	4¾	2	10½	3	4¼	3	10	4	3¾	4	9½
6	1	0	1	6	2	0	2	6	3	0	3	6	4	0	4	6	5	0
6¼	1	0½	1	6¾	2	1	2	7¼	3	1½	3	7¾	4	2	4	8¼	5	2½
6½	1	1	1	7½	2	2	2	8½	3	3	3	9½	4	4	4	10½	5	5
6¾	1	1½	1	8¼	2	3	2	9¾	3	4½	3	11¼	4	6	5	0¾	5	7½
7	1	2	1	9	2	4	2	11	3	6	4	1	4	8	5	3	5	10
7¼	1	2½	1	9¾	2	5	3	0¼	3	7½	4	2¾	4	10	5	5¼	6	0½
7½	1	3	1	10½	2	6	3	1½	3	9	4	4½	5	0	5	7½	6	3
7¾	1	3½	1	11¼	2	7	3	2¾	3	10½	4	6¼	5	2	5	9¾	6	5½
8	1	4	2	0	2	8	3	4	4	0	4	8	5	4	6	0	6	8
8¼	1	4½	2	0¾	2	9	3	5¼	4	1½	4	9¾	5	6	6	2¼	6	10½
8½	1	5	2	1½	2	10	3	6½	4	3	4	11½	5	8	6	4½	7	1
8¾	1	5½	2	2¼	2	11	3	7¾	4	4½	5	1¼	5	10	6	6¾	7	3½
9	1	6	2	3	3	0	3	9	4	6	5	3	6	0	6	9	7	6
9¼	1	6½	2	3¾	3	1	3	10¼	4	7½	5	4¾	6	2	6	11¼	7	8½
9½	1	7	2	4½	3	2	3	11½	4	9	5	6½	6	4	7	1½	7	11
9¾	1	7½	2	5¼	3	3	4	0¾	4	10½	5	8¼	6	6	7	3¾	8	1½
10	1	8	2	6	3	4	4	2	5	0	5	10	6	8	7	6	8	4
10¼	1	8½	2	6¾	3	5	4	3¼	5	1½	5	11¾	6	10	7	8¼	8	6½
10½	1	9	2	7½	3	6	4	4½	5	3	6	1½	7	0	7	10½	8	9
10¾	1	9½	2	8¼	3	7	4	5¾	5	4½	6	3¼	7	2	8	0¾	8	11½
11	1	10	2	9	3	8	4	7	5	6	6	5	7	4	8	3	9	2
11¼	1	10½	2	9¾	3	9	4	8¼	5	7½	6	6¾	7	6	8	5¼	9	4½
11½	1	11	2	10½	3	10	4	9½	5	9	6	8½	7	8	8	7½	9	7
11¾	1	11½	2	11¼	3	11	4	10¾	5	10½	6	10¼	7	10	8	9¾	9	9½

LIST OF NAMES GIVEN IN THE OLDER LANGUAGE OF CHEMISTRY TO VARIOUS COMPOUNDS.

Old Name.	Modern Name.
Salt (ammoniacal, fixed)	Calcium chloride.
,, (ammoniacal, secret) of Glauber.	Ammonium sulphate.
,, (arsenical, neutral) of Macqueer.	Potassium hydrogen arsenate.
,, (bitter, cathartic)	Magnesium sulphate.
,, (common)	Sodium chloride.
,, (digestive) of Sylvius	Potassium acetate.
,, (diuretic)	Potassium acetate.
,, (Epsom)	Magnesium sulphate.
,, (febrifuge) of Sylvius	Potassium chloride.
,, (fusible)	Ammonium phosphate.
,, (fusible) of urine	Sodium ammoniumphosphate.
,, (Glauber's)	Sodium sulphate.
,, (marine)	Sodium chloride.
,, (marine, argillaceous)	Aluminium chloride.
,, (microcosmic)	Sodium ammoniumphosphate.
,, (nitrous ammoniacal)	Ammonium nitrate.
,, of amber	Succinic acid.
,, of benzoin	Benzoic acid.
,, of canal	Magnesium sulphate.
,, of colcothar	Ferrosum sulphate.
,, of egra	Magnesium sulphate.
,, of lemons (essential)	Potassium hydrogen oxalate.
,, of saturn	Lead acetate.
,, of sedlitz	Magnesium sulphate.
,, of seignette	Sodium potassium tartrate.
,, of soda	Sodium carbonate.
,, of sorrel	Potassium hydrogen oxalate.
,, of tartar	Potassium carbonate.
,, of vitriol	Zinc sulphate.
,, of wisdom	Ammonio-mercury chloride.
,, (perlate)	Disodium phosphate.
,, (polychrest) of Glaser	Potassium sulphate.
,, (sedative)	Boric acid.
,, (spirit of)	Hydrochloric acid.
,, (sulphureous) of Stahl	Potassium sulphite.
,, (wonderful)	Sodium sulphate.
,, (wonderful, perlate)	Disodium phosphate.

Table showing the Equivalence of various Salts used in Photography.

	Ammonium Bromide.	Potassium Bromide.	Sodium Bromide.	Cadmium Bromide. (Coml.)	Cadmium Bromide. (Anhyd.)	Zinc Bromide.	Ammonium Chloride.	Sodium Chloride.	Ammonium Iodide.	Potassium Iodide.	Sodium Iodide.	Cadmium Iodide.	Silver Nitrate.	Silver Compound produced.
Ammonium bromide	1	·823	·951	·57	·72	·87	1·832	1·675	·676	·59	·653	·535	1·734	1·918
Potassium ,,	1·215	1	1·156	·692	·876	1·058	2·226	2·036	·821	·717	·794	·651	1·427	1·578
Sodium ,,	1·051	·865	1	·599	·757	·915	1·925	1·761	·71	·62	·686	·563	1·650	1·825
Cadmium ,, com.	1·755	1·444	1·67	1	1·265	1·527	3·215	2·94	1·186	1·035	1·146	·94	·988	1·093
,, ,, anh.	1·387	1·141	1·32	·79	1	1·207	2·542	2·324	·938	·819	·906	·743	1·25	1·382
Zinc ,,	1·149	·945	1·093	·655	·828	1	2·104	1·925	·776	·678	·75	·615	1·509	1·670
Ammonium chloride	·546	·449	·519	·311	·393	·475	1	·914	·369	·322	·356	·292	3·177	2·682
Sodium ,,	·597	·491	·568	·34	·43	·519	1·093	1	·403	·352	·39	·319	2·906	2·453
Ammonium iodide..	1·479	1·217	1·408	·843	1·066	1·287	2·712	2·478	1	·873	·966	·792	1·172	1·620
Potassium ,,	1·695	1·394	1·612	·965	1·221	1·475	3·104	2·839	1·145	1	1·107	·907	1·023	1·415
Sodium ,,	1·53	1·259	1·456	·872	1·103	1·332	2·803	2·564	1·034	·903	1	·819	1·133	1·566
Cadmium ,,	1·867	1·536	1·776	1·064	1·345	1·625	3·42	3·128	1·262	1·102	1·22	1	·929	1·284
Silver nitrate	·576	·700	·606	1·012	·800	·663	·315	·344	·853	·977	·882	1·076	1	—
Soluble compound required	·521	·633	·548	·915	·723	·600	·373	·408	·617	·707	·638	·778	—	—

Weight of silver chloride produced ·844; of silver bromide 1·106; of silver iodide 1·382.

TABLE FOR ENLARGEMENT OR DIMINUTION.

Focus of Lens.	Reduction.	Times of Enlargement or Reduction.								Enlargement.	Remarks.
		1	2	3	4	5	6	7	8		
in.											
2	u	4	6	8	10	12	14	16	18	v	v = distance of image and u = distance of object from optical centre.
	v	4	3	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{2}{5}$	$2\frac{1}{3}$	$2\frac{2}{7}$	$2\frac{1}{4}$	u	
$2\frac{1}{2}$	u	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15	$17\frac{1}{2}$	20	$22\frac{1}{2}$	v	
	v	5	$3\frac{3}{4}$	$3\frac{1}{3}$	$3\frac{1}{8}$	3	$2\frac{11}{12}$	$2\frac{6}{7}$	$2\frac{13}{16}$	u	
3	u	6	9	12	15	18	21	24	27	v	
	v	6	$4\frac{1}{2}$	4	$3\frac{3}{4}$	$3\frac{3}{5}$	$3\frac{1}{2}$	$3\frac{3}{7}$	$3\frac{3}{8}$	u	
$3\frac{1}{2}$	u	7	$10\frac{1}{2}$	14	$17\frac{1}{2}$	21	$24\frac{1}{2}$	28	$31\frac{1}{2}$	v	
	v	7	$5\frac{1}{4}$	$4\frac{2}{3}$	$4\frac{3}{4}$	$4\frac{1}{5}$	$4\frac{1}{12}$	4	$3\frac{15}{16}$	u	
4	u	8	12	16	20	24	28	32	36	v	
	v	8	6	$5\frac{1}{4}$	5	$4\frac{4}{5}$	$4\frac{2}{3}$	$4\frac{4}{7}$	$4\frac{1}{2}$	u	
$4\frac{1}{2}$	u	9	$13\frac{1}{2}$	18	$22\frac{1}{2}$	27	$31\frac{1}{2}$	36	$40\frac{1}{2}$	v	
	v	9	$6\frac{3}{4}$	6	$5\frac{5}{8}$	$5\frac{2}{5}$	$5\frac{1}{4}$	$5\frac{1}{7}$	$5\frac{1}{16}$	u	
5	u	10	15	20	25	30	35	40	45	v	
	v	10	$7\frac{1}{2}$	$6\frac{2}{3}$	$6\frac{1}{4}$	6	$5\frac{5}{6}$	$5\frac{5}{7}$	$5\frac{5}{8}$	u	
$5\frac{1}{2}$	u	11	$16\frac{1}{2}$	22	$27\frac{1}{2}$	33	$38\frac{1}{2}$	44	$49\frac{1}{2}$	v	
	v	11	$8\frac{1}{4}$	$7\frac{1}{3}$	$6\frac{7}{8}$	$6\frac{1}{2}$	$6\frac{5}{12}$	$6\frac{2}{7}$	$6\frac{3}{16}$	u	
6	u	12	18	24	30	36	42	48	54	v	
	v	12	9	8	$7\frac{1}{2}$	$7\frac{1}{6}$	7	$6\frac{6}{7}$	$6\frac{3}{4}$	u	
$6\frac{1}{2}$	u	13	$19\frac{1}{2}$	26	$32\frac{1}{2}$	39	$45\frac{1}{2}$	52	56	v	
	v	13	$9\frac{3}{4}$	$8\frac{2}{3}$	$8\frac{1}{8}$	$7\frac{4}{5}$	$7\frac{7}{12}$	$7\frac{3}{7}$	7	u	

TABLE FOR ENLARGEMENT OR DIMINUTION—*continued.*

Focus of Lens.	Reduction.	Times of Enlargement or Reduction.								Enlargement.	Remarks.
		1	2	3	4	5	6	7	8		
in.											
7	u	14	21	28	35	42	49	56	63	v	v = distance of image and u = distance of object from optical centre.
	v	14	$10\frac{1}{2}$	$9\frac{1}{3}$	$8\frac{3}{4}$	$8\frac{2}{5}$	$8\frac{1}{6}$	8	$7\frac{7}{8}$	u	
$7\frac{1}{2}$	u	15	$22\frac{1}{2}$	30	$37\frac{1}{2}$	45	$52\frac{1}{2}$	60	68	v	
	v	15	$11\frac{1}{4}$	10	$9\frac{3}{8}$	9	$8\frac{3}{4}$	$8\frac{4}{7}$	$8\frac{1}{2}$	u	
8	u	16	24	32	40	48	56	64	72	v	
	v	16	12	$10\frac{2}{3}$	10	$9\frac{3}{5}$	$9\frac{1}{3}$	$9\frac{1}{7}$	9	u	
$8\frac{1}{2}$	u	17	$25\frac{1}{2}$	34	$42\frac{1}{2}$	51	$59\frac{1}{2}$	68	77	v	
	v	17	$12\frac{3}{4}$	$11\frac{1}{3}$	$10\frac{5}{8}$	$10\frac{1}{5}$	$9\frac{7}{12}$	$9\frac{5}{7}$	$9\frac{5}{8}$	u	
9	u	18	27	36	45	54	63	72	81	v	
	v	18	$13\frac{1}{2}$	12	$11\frac{1}{4}$	$10\frac{7}{8}$	$10\frac{1}{2}$	$10\frac{2}{7}$	$10\frac{6}{8}$	u	
$9\frac{1}{2}$	u	19	$28\frac{1}{2}$	38	$47\frac{1}{2}$	57	$66\frac{1}{2}$	76	86	v	
	v	19	$14\frac{1}{4}$	$12\frac{2}{3}$	$11\frac{7}{8}$	$11\frac{2}{5}$	$11\frac{1}{12}$	$10\frac{6}{7}$	$10\frac{5}{8}$	u	
10	u	20	30	40	50	60	70	80	90	v	
	v	20	15	$13\frac{1}{3}$	$12\frac{1}{2}$	12	$11\frac{2}{3}$	$11\frac{3}{7}$	$11\frac{1}{4}$	u	
$10\frac{1}{2}$	u	21	$31\frac{1}{2}$	42	$52\frac{1}{2}$	63	$73\frac{1}{2}$	84	95	v	
	v	21	$15\frac{2}{3}$	14	$13\frac{1}{8}$	$12\frac{3}{5}$	$12\frac{3}{4}$	12	$11\frac{7}{8}$	u	
11	u	22	33	44	55	66	77	88	99	v	
	v	22	$16\frac{1}{2}$	$14\frac{2}{3}$	$13\frac{3}{4}$	$13\frac{1}{3}$	$12\frac{5}{6}$	$12\frac{4}{7}$	$12\frac{3}{8}$	u	
$11\frac{1}{2}$	u	23	$34\frac{1}{2}$	46	$57\frac{1}{2}$	69	$80\frac{1}{2}$	92	104	v	
	v	23	$17\frac{1}{4}$	$15\frac{1}{3}$	$14\frac{3}{8}$	$13\frac{4}{5}$	$13\frac{5}{12}$	$13\frac{1}{7}$	13	u	
12	u	24	36	48	60	72	84	96	108	v	
	v	24	18	16	15	$14\frac{2}{5}$	14	$13\frac{5}{7}$	$13\frac{1}{2}$	u	

FORMULÆ FOR PREPARATION OF PYROXYLINE.

	Sulphuric Acid.	Nitric Acid (or Nitre).	Water.	Dry Cotton Wool (purified).	Remarks.
1. Metrical ..	219 c.c.	73 c.c.	57·5 c.c.	10 G.	Hardwick's formula.
English ..	7½ fl. ℥	2½ fl. ℥	2 fl. ℥	150 grns.	
	S.G. 1·845	S.G. 1·457			
2. Metrical ..	219 c.c.	83 c.c.	51·5 c.c.	10 G.	Hardwick's formula.
English ..	7½ fl. ℥	2¾ fl. ℥	1¾ fl. ℥	150 grns.	
	S.G. 1·845	S.G. 1·45			
3. Metrical ..	425 c.c.	248 G.	71 c.c.	10 G.	Hardwick's formula.
English ..	14½ fl. ℥	8½ oz. potash nitre	2½ fl. ℥	150 grns.	
	S.G. 1·84				
4. Metrical ..	282 c.c.	188 c.c.	..	10 G.	Simpson's formula.
English ..	9¾ fl. ℥	6½ fl. ℥	..	150 grns.	
	S.G. 1·84	S.G. 1·36			
5. Metrical ..	262 c.c.	174 c.c.	75 c.c.	10 G.	Warnerke's formula. (see note)
English ..	9 fl. ℥	6 fl. ℥	19 ℥	150 grns.	

NOTE.—The wool should be purified by digestion with sodium carbonate, washed and dried. The acid should be at a temp. of 150° F. = 65·5° C. when the wool is immersed. In Warnerke's form. the wool is previously impregnated with 3 G. or 46 grains respectively of gelatin.

VARIOUS FORMULÆ FOR IODIZED COLLODION.

	No. 1.		No. 2.		No. 3.		No. 4.	
Ammonium iodide	—	—	—	—	35 gr.	2·0 G.	30 gr.	1·76 G.
Cadmium „	45 gr.	2·90 G.	36 gr.	2·05 G.	—	—	5 gr.	29 G.
Ammonium bromide	—	—	—	—	—	—	16·5 gr.	8·8 G.
Cadmium „	20 gr.	1·14 G.	20 gr.	1·14 G.	10·8 gr.	·62 G.	—	—
Collodion	10 oz.	250 c.c.	10 oz	250 c.c.	10 oz.	250 c.c.	10 oz.	250 c.c.

	No. 5.		No. 6.		No. 7.	
Ammonium iodide	16·6 gr.	·88 G.	40 gr.	2·5 G.	—	—
Cadmium „	22·5 gr.	1·33 G.	—	—	44 gr.	2·5 G.
Ammonium bromide	—	—	—	—	—	—
Cadmium „	20 gr.	1·15 G.	—	—	—	—
Collodion	10 oz.	250 c.c.	10 oz.	250 c.c.	10 oz.	250 c.c.

FORMULÆ FOR WET-PLATE DEVELOPERS.

	No. 1.		No. 2.	
Ferrous sulphate crys.	110 grns.	or 8 G.	225 grns.	or 14 G.
Glacial acetic acid ..	¼ oz.	„ 8 c.c.	225 „	„ 14 „
Alcohol	1 „	„ 30 „	—	—
Water	8 „	„ 250 „	9 oz.	„ 250 c.c.
Copper sulphate crys.	—	—	21 grns.	„ 1·3 G.

These formulæ are given as indicating the general nature of the developers made with ferrous salts. These developers vary greatly in strength and composition. Increase in the amount of ferrous salts increases the intensity of their action and *vice versâ*.

INTENSIFIER FOR WET PLATES.

Sol. 1.	Pyrogallic acid	30 grns.	or 1·8 G.
	Water..	10 oz.	„ 250 cc.
Sol. 2.	Silver nitrate	10 grns.	„ ·6 G.
	Citric acid	20 „	„ 1·2 „
	Acetic acid..	1 ʒ	„ 3·6 „
	Water..	1 oz.	„ 25 c.c.

Mix a few drops of Sol. 2 with enough of Sol. 1 to well cover the plate.

FIXING SOLUTION FOR WET AND DRY PLATES.

Sodium thiosulphate (hypo) ..	1½ oz.	or 42 G.
Water	9 „	„ 250 c.c.

FORMULA FOR A NEGATIVE VARNISH.

Sandarac	1¼ oz.	or 35½ G.
Alcohol	8½ „	„ 227 „
Oil of lavender	1 „	„ 28 „
Chloroform	1½ dr.	„ 6 „

FORMULA FOR A NEGATIVE VARNISH.

Sandarac	1¾ oz.	or 35 G.
Turpentine oil	⅝ „	„ 17·6 „
Lavender oil	¼ „	„ 7·2 „
Alcohol	10 „	„ 250 c.c.

FORMULA FOR A RETOUCHING VARNISH.

Sandarac	1½ oz.	or 42	G.
Castor oil	120 grns.	„	7·75 „
Absolute Alcohol	9 oz.	„	250 c.c.

FORMULÆ FOR VARNISH TO IMITATE GROUND GLASS.

(1.)

Sandarac	360 grns.	or	25 G.
Mastic	80 „	„	6 „
Ether	8 oz.	„	250 c.c.
Benzole	2 to 6 oz.	„	60 to 200 c.c.

The effect produced depends upon the amount of the benzole.

(2.)

A solution of white wax in ether.

VARIOUS PYROGALLOL DEVELOPERS FOR GELATIN PLATES.

Calculated by Mr. GEO. MARSH JONES.

It is assumed that the solutions when made up according to the maker's formulæ measure the following quantities.

	No. 1. ℥	No. 2. ℥	No. 3. ℥
1. "Maudsley's studio"	110	80	—
2. „ other form. concd. ..	8	8	—
3. „ „ „ diluted ..	16	16	—
4. London ordinary	1	1	1
5. „ instantaneous	2	3	—
6. Newark extra sensitive	16	16	—
7. Kingston special	8	8	—
8. Clarke's	10	6, 8 or 10.	
9. "Britannia" or La Brillantine ..	6	20	—

NOTE.—No. 4 Plates. Begin development with ℥ 1 (30 c.c.) of No. 1 Solution, and ♏ 3 (3 drops) each of Solutions 2 and 3; more of No. 2 to follow.

No. 5 Plates. Soak in water, then apply pyro. solution ℥ 2 and begin with ♏ 5 of ammonia; after lights are out ♏ 15 to ♏ 20 more of ammonia solution.

No. 7 Plates. Dilute ℥ 1 of each solution with ℥ 15 water, and use equal quantities of each.

No. 1 SOLUTION.

	No. 1.		No. 2.		No. 3.	
Pyrogallol	39·7 gr.	2·27 G.	547 gr.	31·19 G.	ʒ 5 of No. 2 diluted to ℥ 10.	15·6 c.c. of No. 2 diluted to 250 c.c.
Glycerol ..	—	—	—	—		
Alcohol (meth.) to	—	—	—	—		
Nitric acid (1·142)	—	—	—	—		
Citric acid	5·5 gr.	·32 G.	150 gr.	8·56 G.		
Ammonium bromide	—	—	—	—		
Hard water	to ℥ 10	250 c.c.	℥ 10	250 c.c.		

	No. 4.		No. 5.		No. 6.	
Pyrogallol	20 gr.	1·14 G.	30 gr.	1·71 G.	20 gr.	1·14 G.
Glycerol ..	—	—	—	—	—	—
Alcohol (meth.) to	Freshly mixed		—	—	—	—
Nitric acid (1·42)			—	—	—	—
Citric acid	—	—	—	—	—	—
Ammonium bromide	—	—	—	—	—	—
Hard water	to ℥ 10	250 c.c.	℥ 10	250 c.c.	℥ 10	250 c.c.

	No. 7.		No. 8.		No. 9.	
Pyrogallol	547 gr.	31·19 G.	40 gr.	2·28 G.	729 gr.	41·59 G.
Glycerol	℥ ʒ ♏ 1 5 20	41·65 c.c.	—	—	—	—
Alcohol (meth.) to	℥ 10	250 c.c.	—	—	—	—
Nitric acid (1·42)	—	—	—	—	33 ♏	·96 c.c.
Citric acid	—	—	4 gr.	2·28 G.	—	—
Ammonium bromide	—	—	—	—	1000 gr.	57 G.
Hard water	to —	—	℥ 10	250 c.c.	℥ 10	250 c.c.

No. 2 SOLUTION.

	No. 1.		No. 2.		No. 3.	
Ammonia S.G. ·880	ʒ 1	3·12 c.c.	℥ 1 ʒ 7	46·9 c.c.	ʒ 5 of No. 2 diluted to ℥ 10.	15·6 c.c. of No, 2 diluted to 250 c.c.
Ammonium bromide	—	—	ʒ 7·5 to ʒ 10	25 to 35 c.c.		
Potassium bromide	20 gr.	1·14 G.	—	—		
Glycerol ..	—	—	—	—		
Water to ..	℥ 10	250 c.c.	℥ 10½	250 c.c.		

	No. 4.		No. 5.		No. 6.	
Ammonia S.G. ·880	ʒ 10	31·24 c.c.	℥ ʒ ♏ 3 2 40	83·32 c.c.	♏ 122·5	5·86 c.c.
Ammonium bromide	—	—	—	—	37·5 gr.	2·14 G.
Potassium bromide	—	—	ʒ 3 20 gr.	11·41 G.	—	—
Glycerol ..	—	—	—	—	—	—
Water to ..	℥ 10	250 c.c.	℥ 10	250 c.c.	℥ 10	250 c.c.

	No. 7.		No. 8.		No. 9.	
Ammonia S.G. ·880	ʒ 10	31·24 c.c.	♏ 100 to ʒ 1.	3 to 5 c.c.	♏ 90	4·7 c.c.
Ammonium bromide	—	—	20 to 33 gr.	1·1 to 2 G.	—	—
Potassium bromide	250 gr.	14·26 G.	—	—	—	—
Glycerol ..	ʒ 10	31 cc.	—	—	—	—
Water to ..	℥ 10	250 c.c.	℥ 10	250 c.c.	℥ 10	250 c.c.

No. 3 SOLUTION.

This is required for No. 4 (London ordinary) and consists of

Potassium bromide	150 gr.	or	8·55 G.
Water to	℥ 10		250 c.c.

ABNEY'S SOLUTION FOR REMOVING GREEN FOG FROM GELATIN NEGATIVES.

Iron perchloride	50 grns.	or	3 G.
Potassium bromide..	30 ,,	,,	2 ,,
Water	4 oz.	,,	100 c.c.

FOR REDUCING DENSITY OF GELATIN NEGATIVES.

Dry bleaching powder	1 part.
Potassium carbonate	2 parts.
Water	20 ,,

Mix the bleaching powder with three-fourths of the water, dissolve the carbonate in the remainder, mix, boil, and filter.

CLEARING SOLUTION FOR GELATIN PLATES.

(To remove pyro. stains after developing.)

Alum	2 oz.	or	50 G.
Citric acid	1 ,,	,,	25 ,,
Water	10 ,,	,,	250 c.c.

INTENSIFIERS FOR GELATIN PLATES.

(1.)

Sulphate of iron and ammonium	1 oz.	or	25 G.
Loaf sugar	1 ,,	,,	25 ,,
Glacial acetic acid	2 ,,	,,	50 c.c.
Albumen (1 egg)	1 ,,	,,	25 G.
Water dist...	20 ,,	,,	500 c.c.

A few drops of silver nitrate solution, 4 grns. per oz. or 2 G. per 100 c.c., must be used with this intensifier.

(2.)

Mercuric chloride (corrosive sublimate)	200 grns.	or	12 G.
Ammonium chloride	200 ,,	,,	12 ,,
Water	10 oz.	,,	250 c.c.

Followed by ammonia solution : 10 drops ammonia (·880) to 1 oz. or 30 c.c.

(3.)

Uranium nitrate	30 grns.	or 2 G.
Potassium ferricyanide (red prussiate)	30 ,,	,, 2 ,,
Water	8 oz.	,, 250 c.c.

In all cases the negative must be washed perfectly free from thiosulphate before intensification.

SOLUTIONS FOR PREPARING SENSITIVE PAPER.

For *albumenizing:*

Ammonium chloride	200 to 400 grns.	or 6 to 12 G.
Alcohol	½ oz.	,, 15 c.c.
Water	9 ,,	,, 250 ,,
Albumen	30 ,,	,, 500 ,,

Add the albumen when the other ingredients are dissolved, shake well, and filter through a bit of sponge.

For *sensitizing:*

Silver nitrate	1 oz.	or 28 G.
Water	9 ,,	,, 250 c.c.

The amount of nitrate should be less in printing from a hard negative, and increased when the negative is weak. Paper floated after sensitizing on a bath of citric acid (2 G. per 30 c.c. water) will keep longer than ordinary paper.

FORMULÆ FOR TONING BATHS.

(1.)

Gold chloride	1 grn.	or ·1 G.
Sodium acetate	30 grns.	,, 2·5 ,,
Water	10 oz.	,, 300 c.c.

This gives warm tones and must not be used until one day old. Wash prints well previous to toning.

(2.)

Gold chloride	1 grn.	or ·1 G.
Sodium bicarbonate	8 grns.	,, ·5 ,,
Water	10 oz.	,, 300 c.c.

This must be used at once.

(3.)

Gold chloride	1 grn.	or	·1 G.
Sodium diphosphate	20 grns.	,,	1·3 ,,
Water	10 oz.	,,	300 c.c.

This gives rich purple tones, but will not keep long.

(4.)

Gold chloride	1 grn.	or	·1 G.
Bleaching powder	1 ,,	,,	·1 ,,
Water	8 oz.	,,	300 c.c.

Raise to boiling, and add a slight excess of precipitated chalk, filter, and cool. This may be used immediately and will keep.

(5.)

(*a*)	Gold chloride	1 grn.	or	·1 G.
	Water	10 oz.	,,	300 c.c.
(*b*)	Borax	100 grns.	or	8 G.
	Water	10 oz.	,,	300 c.c.

Mix equal volumes of *a* and *b*. The solutions *a* and *b* will keep, but the mixture, which can be used at once, will not keep. Wash the prints well before toning.

FORMULA FOR FIXING PRINTS.

Sodium thiosulphate (hypo.)	4 oz.	or	100 G.
Water	1 pint	,,	500 c.c.

FORMULA FOR PRINTING IN BLUE. WHITE LINES ON BLUE GROUND.

Potassium ferricyanide	5 oz.	or	150 G.
Ammonio-citrate of iron ..	5 ,,	,,	150 ,,
Water	20 ,,	,,	600 c.c.

Dissolve each of the salts in half the water, mix, and coat one side of the paper. Expose to light and develop by floating in water.

PELLET'S PROCESS FOR PRINTING IN BLUE ON A WHITE GROUND, is said to be :—

Common salt	3 oz.	or	85 G.
Iron perchloride	8 ,,	,,	227 ,,
Tartaric acid	3¼ ,,	,,	92 ,,
Water	100 ,,	,,	3 litres.
Gum arabic	25 ,,	,,	700 G.

Dissolve the gum in half of the water and mix. Coat well sized paper with the mixture in a dim light and dry rapidly. Expose and float on a saturated solution of potassium ferrocyanide. Float on clean water for a few minutes and then upon

Hydrochloric acid	8 parts.
Sulphuric acid	3 ,,
Water	100 ,,

Then wash with water and dry.

ENCAUSTIC PASTE.

(1.)

White beeswax	500 grns.	or	50 G.
Gum elemi	10 ,,	,,	1 ,,
Benzole	220 ,,	,,	22 ,,
Oil of lavender	330 ,,	,,	33 ,,
Oil of spike	50 ,,	,,	5 ,,

(2.)

White wax	1 part.
Oil of turpentine	1 ,,

SOLUTIONS FOR MOUNTING PRINTS.

(1.)

Gelatin	8 oz.	or	80 G.
Water	30 ,,	,,	300 c.
Glycerin	2 ,,	,,	20 G.
Alcohol (meth.)	10 ,,	,,	100 c.

Add the spirit last.

(2.)

Gelatin	1 part.
Alcohol (meth.)	10 parts.

Swell the gelatin with water and boil with the alcohol.

INDEX.

PAGE

A

Acids, Examination for 384
Air, Solubility of, in Water 280
—— Thermometer, compared with Mercurial .. 150
—— Weight of 1 cm.^{3} 346, 347
Alcohol and Water, B.P. of Mixtures of 500
——— Section 482
——— S.G. of, Correction for Temperature .. 498
——— Solubility of Gases in 281
——— Strength from S.G. 483
——— Tralles' Tables for 490–497
Alkalimetric Degrees, Comparison of 531
Alkaloids, Detection of 402
Analysis, Factors for use in 66
——— Qualitative 363
Animal Secretions, Analysis of 393
Aqueous Vapour, Tension of, in mm. of Mercury 336-339, 340
Areas and Volumes of Bodies 13
—— of Circles in Gallons 15–23
—— of Semi-Squares in Gallons.. 24–32
Areometers (see Hydrometers).
Atomic Heats of Elements 34–57
——— Volume of Elements 34–57
——— Weights 34–57
——— ——— Multiples of 63–65

B

Barometers, Comparison of 153–156
——— Correction of 157–160
——— Reduction to 0° C. 155
Baumé's Hydrometer, Varieties of 168
Beer, Section, Analysis, Tables, &c. 501
—— Spirit Indication Tables 503, 504

PAGE

Boiling Point of Water, Variation with Pressure 521
—— Points of Elements 34–57
—— of Saturated Solutions 282
—— of Substances 237–277
Borax Bead Test 373

C

Calculation of Volume of Gases 291, 292
Calculations of Water Analysis 443
Calculi, Analysis of 395
Carats into Decimal Equivalents 466
Carbonic Acid, Absorption in HCl 454
—— Weight of 1 cm.^{3} 360
Casks, Volume of Contents 14
Chemical Calculations 91–93
Chlorometric Degrees, Comparison of 513
Circles, Areas of, in Gallons 15–23
Colour Reactions 389
Conductivity, Electrical, of Elements 34–57
—— Thermal, of Elements 34–57
Contractions used, Explanation of some 278
Correction of Volume of Gas for Temperature and Pressure 293 *et seq.*
Crystalline Form of Elements 34–57
Cubes and Cube Roots of Numbers 1 to 100 9
Cupellation of Gold, Corrections 468
—— of Silver, Corrections 467
—— Lead necessary in 467, 468
Currents of Air, Speed of 527
Cyclic System of Elements 61–62

D

Density of Water at Different Temperatures 361
—— Ordinary Temperatures 345
Dew Point Tables 161–163
Dilation of Glass 341
Dilution of Solutions to Lower Gravity 236
Ductility of Elements 34–57
Dry Method of Analysis 375

E

Electric Conductivity of Elements 34–57
Elements, Atomic Heats of 34–57
—— Atomic Volume of 34–57
—— Atomic Weights of 34–57

PAGE

Elements, Density of 34–57
———— Molecular Weights of 34–57
———— Sp. Gr. of 34–57
———— Specific Heat of 34–57
Equivalents of Elements 34–57
Eudiometry 291
Expansion, Linear, of Solids, Glass, Brass, &c. .. 520
———— of Water, Kopp's Table 345
———— Thermal, of Elements.. 34–57

F

Factors, and Logs of.. 66–90
——— for Fehling's Test 518
——— for Volumetric Solutions.. 433
Freezing Mixtures 151
Frigorific Mixtures 151
Fusing (Melting) Points of Substances 237–277, 283
——— Points of Substances 522

G

Gas Analysis 456
Gases, Solubility in Water and Alcohol 281
——— Tension of Vapours of 524
Glass, Dilation of 341
Glucosides, Detection of 402
Grains per Gallon to Parts per 100,000 348

H

Hardness, Table of 451
Heat Conductivity of Elements 34–57
Hydrometers 167–172

I

Indirect Analysis 469
Indicators, Use of 404

K

Kjeldahl's Method, Table for 414
Kopp's Table, Expansion of Water 345

L

Lead Ores, Assay Tables.. 462
——— Solubility in Presence of Salts 279–280
Logarithms, How to Use.. 8
———— of Numbers 0 to 1200 1–7

PAGE

M

Malleability of Elements 34–57
Malt Extract, Table of S.G. of 507
Manganese Mud, Bases in, Table for 534
Manipulation 472
Mathematical Tables .. .. 1 *et seq.*
Measures and Weights 94–136
Melting Points of Elements 34–57
——— of Substances 237–277, 283
Mercury Pressure, Transformation to Water Pressure 344
——— Vapour, Tension of 341
Milk, Table for Variation of S.G. with Temp. .. 537
Microcosmic Salt Bead Test 374
Mineralogy Table 476
Mixed Chlorides, Table for Analysis of 413
Molecular Weights of Elements 34–57
Multiples of Atomic Weights 63–65

N

Nitrogen Absorption in Hypochlorite Solution .. 455
——— by Sprengel's Method, Table for 450
——— Conversion to Albumenoids 413
——— Conversion to NH_3 413
——— Loss of, by Evaporation 447
——— Reduction of $cm.^3$ to Grams 348
——— Weight of 1 $cm.^3$ 350

O

Older Names of Substances 340
Organic Substances, Behaviour with Solvents 284–290
Oxygen dissolved by Water 42

P

Parts per 100,000 to Grams per Gallon 348
Periodic System of Elements 58–62
Photography, Various Tables 541–553
Physical Properties of Elements 34–57
——— of Substances 237–277
Polarimeters 510–512
π, $n\pi$, $n^2\frac{\pi}{4}$, &c., Values of 11, 13

PAGE

R

Ready Reckoner 539
Reagents, Preparation of.. 363
Reduction of Gases to Normal Temperature and Pressure 293–335
Residual Gases from Vitriol Chambers, Table for 535

S

Saccharometers 510
Salt in Beer.. 505
Saturated Solutions, Boiling Points of 282
Semi-Squares, Areas of, in Gallons 24–32
Silver Assay, Table for 464, 465
Solubility of Air in Water 280
——— Lead in Presence of Salts.. .. 279, 280
——— Substances 237–277
Solutions, Strength of, by Specific Gravity .. 173–236
Specific Gravities of Common Substances 166
——— Substances 237–277
Specific Gravity, Air to Hydrogen Standard .. 14
——— Compared with Hydrometers 169–172
——— Methods of Obtaining .. 164–166
——— of Various Solutions 173–236
Specific Heat of Elements 34–57
——— Rotatory Power of Sugars 509
Squares and Square Roots of Numbers 1 to 100.. 9
Steam, Properties of.. .. .. 342, 343
Strength of Solutions by Specific Gravity .. 173–236
Sugar, Section, Analysis, Tables, &c. 508
——— Solutions, S.G. of 515–517

T

Tension of Aqueous Vapour in mm. of Mercury 336–339, 340
——— Mercury Vapour 341
Thermal Conductivity of Elements 34–57
——— Expansion of Elements 34–57
Thermometers, Air and Mercurial 150
——— Conversion of.. 137–148
——— Correction of 149
Transformation of Water Pressure to Mercury Pressure 344
Twaddle's Hydrometer 14, 167

PAGE

U

Urine, Analysis of 398

V

Volume of Water at Different Temperatures .. 361
Volumes of Bodies 13
——— Gases, Reductions of 292
Volumetric Analysis 403
Vomit, Analysis of 401

W

Wages Table 538
Water Analysis 441
——— Density of, at Ordinary Temperatures .. 345
——— Kopp's Table for Expansion of 345
——— Pressure, Transformation to Mercury Pressure 344
——— Solubility of Gases in 280, 281
——— Vapour, Tension of, in mm. of Mercury 336, 340
Weight in Air to Weight in Vacuo 14
Weights and Measures 94–136
——— of Various Substances 526

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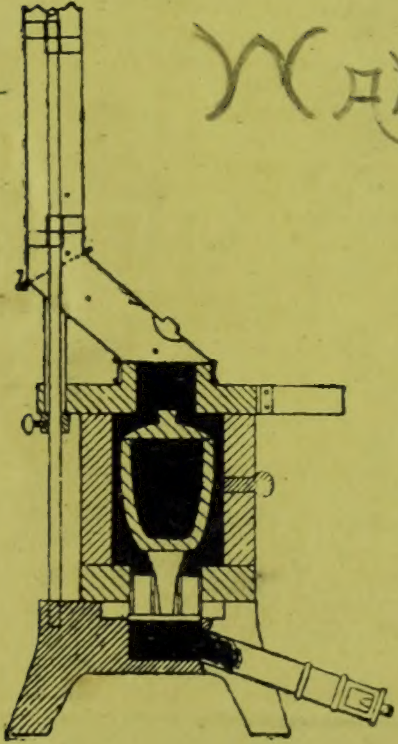

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